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Bio-Fuels

Bio Fuels Canada

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Report Highlights:
Although policies promoting domestic ethanol production and consumption have been in place since the 1980s, the Canadian biofuels industry has remained in its infancy. However, in late 2006, the Canadian government made the political decision to implement a bio-fuel strategy that will result in a significant increase in Canadian bio-fuel production capacity. As part of this strategy, the Government of Canada has notified its intent to mandate a five percent renewable fuel content in the gasoline pool by 2010, and a two percent requirement for renewable fuel in diesel content by 2012. The possibility of increased corn imports from the United States to feed the expanding ethanol production in eastern Canada is uncertain. A decreasing Canadian livestock industry, the availability of feed substitutes and untapped corn growing potential in Quebec and Ontario may mitigate the need for increased corn imports into eastern Canada for ethanol production. More wheat-based ethanol production is expected in western Canada, but inadequate transportation and distribution channels limit Canadian ethanol export potential to the U.S.

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Table of Contents

1. Executive Summary

Although policies promoting domestic ethanol production and consumption have been in place since the 1980s, Canada remains in its infancy when it comes to bio-fuels production. This has begun to change under the current government, which, in late 2006, made the political decision to implement a bio-fuel strategy that will result in a significant increase in Canadian bio-fuel production capacity. As part of this strategy, the Government of Canada (GOC) has notified its intent to mandate a five percent renewable fuel content in the gasoline pool by 2010, and a two percent requirement for renewable fuel in diesel content by 2012, upon the successful demonstration of renewable diesel fuel in a range of climatic conditions. To meet this mandate, a minimum of 1.9 billion liters of renewable fuel is needed for gasoline and would require more than doubling Canada's current production capacity of 700 million liters. The 2% bio-diesel mandate will require 520 million liters of bio-diesel. To meet this mandate through Canadian produced bio-diesel, Canadian production capacity would have to increase five-fold from current bio-diesel production capacity.

Many investors were waiting for the announcement of the federal government's strategy (the mandate, programs, incentives) before committing to supplying the Canadian market with Canadian-produced ethanol. Without the production incentives and additional support being provided by both the federal and provincial governments, it is unlikely that a Canadian renewable fuel standard would have been met by Canadian bio-fuels production instead of U.S. produced ethanol. Even with production incentives in place, the long-term viability of producing bio-fuels in Canada will depend on a multitude of factors including size, production types, co-products, feedstock costs, and energy prices. The required increase in bio-fuel production set out by the federal mandate will likely necessitate a movement away from food and grain crops to growing crops for an industrial purpose and will have a significant impact on agriculture, as it will affect other grains, livestock, and agricultural land values.

The possibility of increased corn imports from the United States to feed the ethanol production markets in the eastern part of Canada is uncertain. Although the incentives and mandate will propel increasing levels of ethanol production which may require inputs of corn beyond Canada's historic corn production levels, Canada's decreasing livestock industry, untapped corn growing potential in Quebec and Ontario, and the ability to use feed substitutes such as DDGs and barley may minimize the impact of Canadian corn production being directed away from feed and into ethanol production. The possibility of increased ethanol trade, especially between the northwest U.S. and Western Canada (wheat-ethanol to the United States and corn-based ethanol to Canada), is unlikely to develop in the short term. This is mainly due to the fact that Canada does not have excess ethanol production capacity, which would permit exports being shipped to the United States. In addition, the transportation, distribution and infrastructure issues around ethanol trade have yet to be resolved.

2. Domestic Policy Environment

Heretofore, in the absence of a federal mandate for renewable fuels content, a significant domestic market for renewable fuels had not developed in Canada. Without a demand driver, the incentives to engage in renewable fuels on a more significant scale have not been great enough to overcome the entrance barriers and lender fears of risk. Since the 1980s, different policies promoting ethanol production and usage in Canada have been implemented. The provinces of Manitoba, Saskatchewan and Ontario have led the way by implementing incentive measures such as exempting the ethanol portion of blended motor fuel from provincial excise tax. Federal incentives included the introduction of a $CDN 0.10 per liter federal excise tax exemption in the 1990's, and in the 2000's, a federal program

called the Ethanol Expansion Program, which provided capital grants and concessional loans, was brought in. Still, no political decision was made to implement a strategy with the express purpose of ensuring the growth of bio-fuels production capacity in Canada.

However, in late 2006, Canada's minority government made the political decision to implement a federal bio-fuel strategy that would result in a substantial increase in ethanol fuel production. Hungry for a majority win, two political drivers pushed through this mandate - the environment became a voter issue, and renewable fuel to raise farm incomes seemed to have wide voter-appeal.

A. Rationales for the Canadian Federal Government Policies

(i) It's Hard Being Green

When under-dog candidate, Stephen Dion, won the Liberal Party (official opposition party) leadership after running on a green-platform, it proved that that environment in 2006/2007 had become an election issue. This was confirmed with poll results showing Canadians' increasing concerns with climate change. In late 2006, Canadians named climate change as one of the top two issues of most importance to Canada and, by early January, environment overtook health as the number one issue for Canadians. The government took notice and added environment to its set of priorities. The government has been struggling with its environmental image since it announced that Canada will not be able to meet its Kyoto Protocol targets, and that it will not take any action that will comprise Canada's booming economy in order to meet these targets. It should be noted that despite having ratified the Kyoto Accord, the previous Canadian government had not taken substantive environmental action for over a decade. When the Conservative party came to power in 2006, they were faced with the difficult choice of environment or economy. A bio-fuels strategy dovetails nicely with the Conservative party's need to be viewed as more "green".

(ii) Rural Revitalization

Since 2002, Canadian farm incomes have declined to their worst in recorded history. Rising farm costs, the rise of the Canadian dollar, and increasing debt have resulted in Canadian grain and oilseed producers being unable to keep the market gains from increased efficiencies. The failure of the Doha Round, and the loss of a corn countervail case against the US have contributed to a certain disillusionment among Canadian grains and oilseeds producers with international markets. In recent years, Canadian farm lobby groups have begun running campaigns such as "Farmers Feed Cities" to sensitize the Canadian public to the crisis facing rural communities.

In contrast, 2003-2006 have been the best four years in US recorded history. Over the last few years, US corn growers have enjoyed record corn prices due to increased levels of ethanol production. This has had a ripple effect on other commodity prices. Increases in US ethanol production are expected to continue, as a new production target of 35 billion gallons of alternative fuels by 2017 was set. This represents a five-fold increase from the current goals and was primarily driven by the U.S. need for energy security. These developments have Canadian grains and oilseeds farmers asking themselves how to position themselves to supply the growing demand for ethanol in the United States.

The government, whose stronghold of support is in rural Canada, does not underestimate the power of agricultural producers to influence public support. A bio-fuels strategy as a policy to revitalize Canadian rural economies has broad voter appeal and can be nationalized across much of the country. Corn-based ethanol production could take place in Quebec and Ontario,

while wheat (ethanol) and canola (bio-diesel) based production of bio-fuels could take place in the western provinces.

Having made to political decision to go forward, the Canadian government began unveiling the first steps of its comprehensive strategy for renewable fuels in late 2006. On December 20th, 2006, the Ministers of Environment and Agriculture made the long-anticipated announcement of the government's intent to mandate a renewable fuel content in transportation fuel. As the year 2007 progressed, the other elements of the strategy were announced, and with the approval of the federal budget in March 2007, most of the strategy has been set.

B. Federal Government's Comprehensive Renewable Fuels Strategy

The government's comprehensive strategy for renewable fuels is comprised of five main objectives. They are:

1.) To create demand at the retail level by introducing regulations that mandate the use of renewable fuels in transportation fuel and heating oil;
2.) To help expand and develop, through federal funding, the Canadian production of renewable fuels and other bio-based products;
3.) To assist farmers in capturing the opportunities in the renewable fuels/bio-economy sector;
4.) To help accelerate the commercialization of new bio-based technologies; and,
5.) To nationalize bio-fuels production.

(i) Creating Demand for Bio-Fuels

The Mandate

A mandate is being developed for an annual renewable content of five percent in the gasoline pool by 2010, and a two percent requirement for renewable fuel in diesel content by 2012, upon the successful demonstration of renewable diesel fuel under a range of Canadian climatic conditions. The regulation is to be developed under the Canadian Environmental Protection Act, 1999. Amendments to the Fuels Division of the Canadian Environmental Protection Act are proposed under Canada's Clear Air Act. A Notice of Intent was published in the Canada Gazette Part 1 on December 30th, 2006.

While there has been a conscientious effort to harmonize regulations with those present in the United States, the requirement of a renewable content in Canadian diesel fuel or distillate goes beyond the renewable fuel standards (RFS) in the United States which do not apply to diesel fuel. The inclusion of a bio-diesel component is likely in response to the strong lobby from oilseed producers, in particular the Canola Council of Canada. Canada is the world's largest producer of canola, producing an estimated 8.5 thousand metric tons of canola in 2006/2007. The reason for the mandate not limiting the diesel renewable fuel content to transportation fuel is that a large share of the diesel fuel pool is not used for transportation. To create equity between ethanol and diesel fuel, and perhaps between grains and oilseeds producers, the mandate was extended to include diesel fuel.

Key Elements of the Regulations

The notice of intent sets out the government's plans to implement a federal renewable fuels regulation in order to give Canadians and industry a good idea of what to expect and allow them time to make the necessary decisions. In short, it sets out the key elements of the government's intentions.

The government expects that the mandate, depending on the price points, will first be met by grain-based or sugar-cane based ethanol (sugar-cane based ethanol would likely be imported from Brazil), and bio-diesel derived from animal or vegetable fats, but sees the development of next-generation fuels such as cellulosic ethanol as being the ultimate goal since this would bring about the greatest benefits to the environment.

In developing the regulations, the Canadian regulators have recognized the fact that there exists an integrated oil and gas market in North America and that any regulations developed must take this into account. Canadian regulators have therefore looked closely at the manner in which the US renewable fuels standard was established.

The Canadian regulations will apply to persons that produce or import gasoline, diesel fuel, or heating oil. In the U.S., the EPA is developing renewable fuel content standard to apply to producers and importers of gasoline. Canadian regulations, like U.S. regulations, may contain some exclusions such as fuels for specific uses (airplanes, competition vehicles, scientific research), or for small volume importers/producers ($400m^3$).

Application of the Regulations

While a clear attempt is being made to nationalize bio-fuels development by creating a firm national mandate, there is the recognition that a 5% bio-fuel standard for all provinces (from Canadian production) would not be possible, especially in the Atlantic provinces and the Northern Territories, which have no current or planned ethanol production. The goal of the Canadian regulators is to have a regulatory structure flexible enough to account for varying regional impacts such as availability of feedstocks, population density, and the climate. Requirements of a renewable fuel content will therefore be based on average volumes and applied on a company wide basis. In other words, companies would be required to have renewable fuel content equal to 5% of their respective gasoline pool. Theoretically, a company's gasoline sold in Saskatchewan, where ethanol fuel will be readily available, could have a higher concentration of renewable fuel, while the company's gasoline sold in areas of the country, where bio-fuel is less readily available such as Newfoundland, could have less or no renewable fuel content, as long as the average renewable fuel content comprises 5% of a company's gasoline pool.

A credit and trading system will also be part of the regulations. An oil and gas company will have the option of obtaining credits from other companies rather than actually having to meet the mandate itself. There will also be no set quality specification for renewable fuels or the final blended product in the regulations, although this will likely develop on its own in the private sector. The notice also indicates that consideration will be given for different renewable fuels such that a liter of one renewable fuel counts more towards meeting the renewable fuel content requirement than would a liter of grain-based ethanol.

Timing of the Mandate

The Minister of the Environment expects to propose a draft Renewable Fuels Regulation in Part I of the Canada Gazette by Fall 2008. A 60-day comment period would follow. Comments will be directed to the Minister of the Environment and sent to the Director of the Oil, Gas, and Energy Branch, Clean Air Directorate, Environmental Stewardship Branch, Environment Canada.

(ii) Providing Supply-side Incentives to Encourage Canadian Ethanol Production

With the announcement of the federal budget in March of 2007, an important shift in the type of incentives took place. The federal tax excise tax incentive that encourages ethanol

consumption but has no "Canadian production" incentive element was replaced with producer incentive payments that will help foster an increase in Canadian ethanol production capacity. The excise tax exemption of $0.10 per liter for ethanol and $0.04 per liter for bio-diesel was eliminated as of April 1, 2007 and replaced with production incentive rates of up to $0.10/L for renewable alternatives to gasoline and $0.20/L for renewable alternatives to diesel for the first three years, declining in the 6 years thereafter. The maximum payable incentive rates are presented in the table 2.1 below:

Table 2.1
Maximum Payable Incentive Rates*; in $Can per L

	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Renewable Alternatives to Gasoline	0.10	0.10	0.10	0.08	0.07	0.06	0.05	0.04	0.04
Renewable Alternatives to Diesel	0.20	0.20	0.20	0.16	0.14	0.12	0.10	0.08	0.06

**by fiscal year; April 1 to March 31*
Source: ecoENERGY for Biofuels, Natural Resources Canada; http://oee.nrcan.gc.ca/transportation/overview.cfm

Additional conditions are that facilities eligible for these incentives must be constructed before March 31, 2011, and meet the as-yet-to be-determined minimum production volume. Eligible facilities would have access to these incentives for a maximum of seven years and must meet certain thresholds for, and reporting of, plant environmental performance.

The March 2007 budget allocates $CAN 1.5 billion over 9 years to the ecoENERGY for Biofuels program. The funding amount was derived based on the establishment of a volume limit of 2 billion liters of renewable alternatives to gasoline and 500 million liters of renewable alternatives to diesel. A cap of 30 percent of the program volume limit per facility (600 million liters and 150 million liters for renewable alternatives to gasoline and diesel, respectively) has also been established.

These supply-side producer incentives are necessary if the Canadian government aims to meet the Canadian renewable fuels mandate through Canadian production and not from imports of ethanol from the United States or Brazil, the two largest ethanol producers in the world. A large body of evidence seems to suggest that without government support, a Canadian grains-based ethanol industry is, and will remain uncompetitive compared to oil, due to the costs of the necessary inputs. Ethanol is not a primary energy source and is achieved by using energy to convert the energy stored in biological material into ethanol. For this reason, ethanol prices and oil prices move in the same direction. Due to the input energy requirements, the energy and environmental benefits of grain-based ethanol production in Canada is questionable. The notice of intent seems to acknowledge this and implies that this measure is just the first step as the real gains to both the environment and agricultural producers across Canada is through the creation of a bio-economy that will come as a result of breakthroughs in the commercialization of cellulosic technologies. To accentuate this point, a half a billion dollar (Canadian) research grant was made to Sustainable Development Technology Canada to advance research in what is being termed "next-generation renewable fuels".

(iii) Ensuring the Ability of Rural Communities to Capture the Opportunities of the Renewable Fuels/Bio-economy Sector

There is no doubt that while the environmental goal of lowering greenhouse gases is the banner under which a federal mandate has been created, the delivery mechanism for meeting the mandate requirement is clearly one designed to help raise grain producer incomes, and help rural communities. The programs developed within the federal government's bio-fuel comprehensive strategy are clearly designed to engage Canadian producers with the idea that they will be able to manage their risk by diversifying their income sources. The programs are designed to involve, as much as possible, Canadian agricultural producers in the renewable fuels market, as well as in the wider bio-economy that would allow them to find new markets, offset financial losses, and diversify income sources.

Since coming to power in the spring of 2006, the minority conservative government has put in place a series of programs to encourage direct producer participation in bio-fuels and the bio-economy. Two programs in particular encourage direct producer involvement in bio-fuels production: the Biofuels Opportunities for Producers Initiative (BOPI) and the ecoAGRICULTURE Biofuels Capital Initiative (ecoABC).

Twenty million dollars of funding has been made available through BOPI since it was first announced in July of 2006. The initiative delivered ten million dollars in funding through the regional industry councils that administer Agriculture and Agri-food Canada's Advancing Canadian Agriculture and Agri-Food Program. The purpose of the program was to help producers hire technical, financial and business planning advisors to assist in developing business proposals to support the creation and expansion of bio-fuels production capacity with significant ownership by agricultural producers. The funding is available for projects with greater than one-third producer ownership. Funding demand was high, and in March of 2007, the Ministry of Agriculture announced that an additional three million dollars would be made available for the 2006-2007 fiscal year, and an additional seven million dollars for fiscal year 2007-2008.

EcoABC is designed to encourage producer equity/ownership in bio-fuel facilities and was first unveiled at the bio-fuels mandate announcement in December 2006 under the unwieldy name "Capital Formation Assistance Program for Renewable Fuels Production". This 4-year, 200 million dollar program was later renamed ecoAGRICULTURE Biofuels Capital Initiative (ecoABC) and provides repayable contributions for the construction or expansion of transportation bio-fuel facilities. Launched in late April 2007, the program helps fund projects that use agricultural feedstock to produce bio-fuels and requires agricultural producer equity investments of 5% to meet the eligibility requirements. The funding increases as producer investment increases, however a contribution cap of 25 million dollar applies. The project ends March 31, 2011.

(iv) Developing a Sustainable Bio-based Economy

The notice of intent suggests that the mandate's ultimate goal is to evolve beyond bio-fuels production to a sustainable, bio-based economy. To advance this goal, two federally funded programs have been developed to help make this leap possible.

Agricultural Bio-products Innovation Program (ABIP) is a 145 million dollar, multi-year program that seeks to mobilize research networks that conduct scientific research projects with a specific focus on developing effective and efficient technologies for an agricultural biomass conversion; and product diversification through technologies such as agricultural

and industrial chemicals, biomaterials and health products. A cap of 25 million per network has been established with an individual project receiving no more than 15 million.

The Agri-Opportunities Program is a 134 million dollar, five-year program that aims to accelerate the commercialization of new agricultural products, processes or services that are currently not produced or commercially available in Canada and that are ready to be delivered to the marketplace. The program is delivered nationally through AAFC and focuses on projects geared to new agri-food, agriculture or bio-products that are expected to increase market opportunities for the Canadian agricultural industry and that can generate a demand for primary agricultural products. The program provides a maximum repayable contribution of $10 million per project and recipient. The target contribution per project is 33% of total project costs.

(v) The Nationalization of Renewable Fuels

As mentioned previously, an effort to develop a national bio-fuels strategy has been made by the grant of 500 million dollars over eight years to Sustainable Development Technology Canada. These funds are to be used in conjunction with the private sector to establish large-scale, next-generation fuel production facilities. This type of technology would nationalize the mandate as non-food feed stocks from across Canada such as wheat straw, corn stover, wood residue and switch grass could be used in the production of bio-fuels. Municipal solid waste and forestry slash in Ontario and Quebec, straw from the Prairies, and mountain pine beetle-damaged wood in western Canada could be used in the production of celluosic ethanol. This also feeds into joint federal and provincial initiatives such as Forestry Innovation, ecoENERGY Technology Initiatives, and the afore-mentioned ABIP and Agri-Opportunities programs. In early July 2007, $48 million dollars in clean technology funding was approved by the Sustainable Development Technology Canada. Among the 19 projects approved in this latest round of funding, several concern renewable fuels, including one project that looks at how to used glycerol, a by-product of bio-diesel production, to help solve the transportation and storage costs that are limiting the market growth of hydrogen.

C. Provincial Policies

While provinces have led the way in terms of developing mandates on renewable fuel contents, inconsistencies in provincial requirements have frustrated the flow of bio-fuel trade within Canada. For example, ethanol produced in Alberta is exempted from Alberta's gas tax, but not exempted from the tax in neighboring British Columbia or Saskatchewan since the exemptions there are only for locally-produced ethanol. With each provincial government implementing its own complex and un-harmonized set of tax exemptions on ethanol with varying amounts, eligibility and duration, the result is barriers to trade flows and the possibility of distorting the market for renewable fuel by encouraging production in areas where this activity is not well suited. Within the notice of intent, the federal government makes note of these barriers and sees the federal mandate as a means for it to work with provinces at reducing the patchwork of provincial mandates that have resulted in inter-provincial trade barriers. However, the ability of the federal government to carry out this role is unclear as federal-provincial relations have become increasingly strained due to certain issues (attempt to remove Canadian Wheat Board single desk powers over barley, equalization payment in recent budget, re-negotiation of cost-sharing for agricultural safety net programs etc.) which have served to undermine federal authority, at least in the short term.

While some provinces have gone forward and implemented provincial mandates on the amount of ethanol required in the gasoline pool, others have held back, waiting for the

national mandate to be announced so that they could align themselves with the federal policy. Table 2.2 summarizes the incentive measures provinces have implemented:

Table 2.2
Provincial Mandates, Incentives, and Conditions

Province	Mandate	Incentives	Conditions
Alberta	none	9 cents/liter provincial fuel tax exemption.	none
British Columbia(BC)	none	14.5 centers/liter provincial tax exemption. The ethanol must be produced and consumed in BC to be eligible	The ethanol must be produced and consumed in BC to be eligible.
Manitoba	8.5% of ethanol content in gasoline (tentative)	20 cents/liter producer incentive beginning January 1, 2008 until Dec 31, 2009. 15 cents/liter producer credit from January 1, 2010 - December 31, 2012 10 cents/litre from January 1, 2013 - December 31, 2015.	To be eligible for the credit, the ethanol would have to be produced in Manitoba
Ontario	All gas sold must contain 5% ethanol, beginning in January 2007; amount increase to 10% by 2010	None	None
Quebec	Intends to mandate 5% ethanol content in gasoline by 2012.	20 cents/liter tax exemption	To be eligible for the exemption, the ethanol must be produced in Quebec
Saksatchewan	All gas sold must contain 7.5% ethanol, began mid-2006.	15 cents/liter provincial tax exemption.	The ethanol must be produced and consumed in Saskatchewan.

(i) Alberta Bio-fuel Policies

Alberta has no provincial renewable fuel content mandate in place, but the province has a 9¢ per liter fuel tax exemption. In October of 2006, Alberta approved 3 program initiatives from its nine-point bioenergy plan.

Approved program initiatives include:

- 24 million $Can through 2008-2009 for the development and commercialization of bio-fuels (capacity building)
- 6 million $Can through 2008-2009 for bio-energy infrastructure development grant program
- 209 million $Can from 2007-2011 for a renewable energy producer credit program

Other proposed policy initiatives in this plan include:

- Energy microgeneration standards and policy revisions
- Bio-industry network development
- Taxation and investment instruments for the bio-energy sector
- Working towards the national renewable standard and energy market targets
- Specified risk material disposal protocol
- Invesment support through existing programs that align with Bioenergy Development.

Ministries sponsoring this plan are Energy; Agriculture, Food and Rural Development; Environment; Sustainable Resource Development; and Innovation and Science. Details on Alberta's bio-fuels development efforts can be found on the following website: http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/com11017

(ii) British Columbia Bio-fuel Policies

One of the early ethanol initiatives for a wheat based ethanol plan, Okanagan Bio-fuels, which was to be located in Kelowna, British Columbia, seems to have stalled as the province has chosen to promote and focus its efforts on hydrogen as a clean source of fuel for the future. This is unsurprising considering that B.C. does not have the feedstock necessary to make a substantive amount of grain-based ethanol production. Some federal and provincial grants have been given to research and develop technologies that would use wood damaged by the pinewood beetle as a feedstock in cellulosic ethanol production.

(iii) Manitoba Bio-Fuel Policies

Manitoba is developing its ethanol industry under the Energy Development Initiative section of the Ministry of Science Technology and Mines. Manitoba never enforced a mandate first brought in 2003 under the Bio-fuels and Gasoline Tax Act due to lack of production capacity. Earlier in the spring of 2007, amendments were proposed for the Act which would update it and align it with the federal and other provincial mandates/incentives. The implementation of The Bio-fuels and Gasoline Tax Amendment Act was delayed due to a spring provincial election, but will likely be re-introduced in the fall. If all goes smoothly, it is expected that a mandate requiring that 8.5% of the gasoline pool contain ethanol will be in effect by January 1, 2008. The tax exemptions previously approved have been amended to be producer credits that decrease over a period of seven years. More information on Manitoba's ethanol initiative is available on the following website: http://www.gov.mb.ca/est/energy/ethanol/ethfacts.html.

(iii) Saskatchewan Bio-fuel Policies

Saskatchewan was an early leader in ethanol production and currently has a 7.5% ethanol content requirement in its gasoline. The Saskatchewan Ministry of Regional Economic and Co-operative Development handles ethanol related issues. In June 2007, the government of Saskatchewan committed 80 million dollars to the development of bio-fuel production facilities under the Saskatchewan Biofuels Investment Opportunity Program (SaskBIO). It is a four-year provincial program that provides repayable contributions of up to $10 million dollars per project. Funding contributions will vary according to plant capacity, costs, and community-farmer investment. An additional $2 million will also be provided for bio-fuels and bio-products research and development. Saskatchewan also recently unveiled its new "green plan" which is available at the following website: http://www.saskatchewan.ca/Default.aspx?DN=3b71929e-0f58-402f-8fee-2954faf80dc8.

Included as a key part of the strategy is the promotion of more environmentally friendly transportation. Initiatives include working with industry to develop E-85 (fuel blends with 85% ethanol and 15% gasoline) corridors in the province, developing a 1.4 billion liter bio-fuels industry in Saskatchewan, and implementing a Government and Crown vehicle purchase policy that requires all vehicles to be hybrid electric, alternative or flex-fuel, or within the top 20 per cent efficiency in their class.

(iv) Ontario Bio-fuel Policies

Ontario is the largest ethanol-producing province in Canada and has been a leader in building ethanol production capacity in Canada. Its ethanol strategy has two components; (1) a renewable fuel standard mandate, and (2) the Ontario Ethanol Growth Fund (OEGF) that was created in 2005. As of January 1, 2007, the gasoline tax exemption of 14.7¢ a liter on the ethanol portion of the ethanol-blended gasoline is no longer in effect. At the same time, a mandate that requires an average of 5% ethanol be blended in the gasoline sold in Ontario came into effect. The OEGF provides:

- 32.5 million $CAN for capital assistance to help meet financial challenges; cannot exceed 10¢ per liter
- 60.5 million per year $CAN from 2007-2017 for operating assistance to address changing market prices; no operating grant will exceed 11¢ per liter of ethanol
- 16 million $CAN in support of independent retailers selling ethanol blends; Independent Gasoline Blender's Transition Fund,
- 7.5 million $CAN in private and public funds for research and development opportunities

(v) Quebec Bio-Fuel Policies

Quebec currently has no mandate in place for a renewable fuel content in gasoline. The provincial government has announced its intention to mandate a 5% bio-fuel content in its gasoline pool by 2012. In addition, there is currently in place a 20¢ per liter fuel tax exemption for the ethanol portion of the gasoline. While some corn production takes place in Quebec, Quebec's focus is on the development of cellulosic ethanol. It is Quebec's intention to use wood from its forestry industry to grow its ethanol market. This technology, however, is still in its developmental stages.

3. Energy Markets

A. Energy Production and Consumption Patterns

Unlike the United States, energy security is not a factor behind the recent and projected growth in Canada's ethanol industry. Canada has the world's second largest proven oil reserves (estimated at 178.3 billion barrels) and is one of the top 10 oil-exporting countries in the world. According to the National Energy Board of Canada (NEB), Canadian production of conventional crude oil and bitumen in 2006 averaged 3.4 million barrels (US Liquid) per day, which represented a 6% increase over 2005 levels. The Canadian Energy Board attributes the increase to integrated oils sands mining plants, expansions at others, and increases in production at the Terra Nova and White Rose fields. Increase in crude oil production is expected to increase 3.8 million barrels (US liquid) per day, up 9 percent compared with 2006 levels. Table 3.1 provides a quick overview of Canadian oil production and consumption patterns from 2000 – 2006.

Table 3.1
Growth in Canadian Production, Consumption and Net Exports*, 2000-2006; in '000 barrels per day

	2000	2001	2002	2003	2004	2005	2006
Canadian Production[1]	2,749	2,813	2,950	3,110	3,135	3,093	3,289
% change		2.3	4.9	5.4	0.08	-1.3	6.3
Total growth (2000-2006)							20%
Canadian Consumption[2]	2,027	2,057	2,078	2,207	2,302	2,303	2,220
% change		1.5	1	6.2	4.3	0	-3.6
Total growth (2000-2006)							10%
Net Exports of Petroleum	792	817	992	992	1,036	983	1,071
% change		3.2	21.5	0	4.4	-5.2	9
Total growth (2000-2006)							35%

*expressed in liquid(l) barrels
Source: Energy Information Agency, US Dept. of Energy
[1] http://tonto.eia.doe.gov/merquery/mer_data.asp?table=T11.01a
[2] http://www.eia.doe.gov/emeu/ipsr/t46.xls

B. Energy Demand by the Transportation Sector

While Canada is a significant producer of oil, it also ranks among the world top 10 consumers of petroleum. As illustrated in table 3.2 on the following page, transportation, on average, accounts for about 22% of total energy demand. Of that share, motor gasoline and diesel fuel oil account for 87% of the energy used (see table 3.4 on following page). Based on data from the US Department of Energy, Canada decreased its consumption of petroleum in 2006 (see table 3.1), and this decrease in consumption was reflected in a decrease in energy consumption in the transportation industry. In 2006, according to the NEB, demand by the

transportation industry decreased by 1.1 percent over 2005 levels (see table 3.2). The decrease in demand is attributed to a variety of factors including sustained higher prices for gasoline, behavioral changes that result from these higher prices such as more using of public transportation. Increased numbers of people working from home, changes in the freight sector and a federal tax credit for using public transit that began July 1, 2006 may have also contributed to the reduction.

Table 3.2
Domestic Energy Consumption [(a)]; in petajoules

	2002	2003	2004	2005	2006	05/06
Space Heating	1,970	2,065	2,032	2,074	2,105	1.49%
Transportation	2,250	2,242	2,346	2,383	2,357	-1.09%
Other Uses	3,164	3,298	3,312	3,399	3,499	2.94%
Non-Energy	894	903	1,018	1,020	1,015	-0.49%
Electricty Generation	1,911	1,850	2,029	2,068	1,973	-4.59%
Total	10,189	10,358	10,737	10,944	10,949	0.05%

(a) includes consumption of imported energy
Source: Statistics Canada, Office of Energy Efficiency, National Energy Board
http://www.neb.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyvrvw/cndnnrgyvrvw2006/cndnnrgyvrvw2006-eng.pdf

A closer look at the use of energy within the transportation industry shows that on average, for the last seven years, the share of energy used for freight averages 41% per year and the share of energy used for passenger transportation averages 54%.

Table 3.3
Energy Use by Transportation Sector; in petajoules

	2000	2001	2002	2003	2004	2005(e)	2006(e)
Total Energy Use	2,282	2,277	2,306	2,362	2,465	2383	2,357
Freight	947	933	938	977	1,035	1,001	966
Passenger	1,255	1,256	1,276	1,292	1,334	1,287	1,249
Off road	80	89	92	93	96	95	94
Shares (%)	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Freight	42%	41%	41%	41%	42%	42%	41%
Passenger	55%	55%	55%	55%	54%	54%	53%
Off road	4%	4%	4%	4%	4%	4%	4%

* years 2005, 2006 are estimates
Source: Office of Energy
http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/tran_ca_1_e_3.cfm

A breakdown of transportation energy use by fuel type reveals that gasoline and diesel fuel account for an average of 58% and 30%, respectively, of the fuel type used, and dominate as the transportation sector's main energy sources (see table 3.4 on the following page).

Table 3.4 Transportation Sector Energy Use by Source; in petajoules					
	2000	2001	2002	2003	2004
Total Energy Use	2,282	2,277	2,306	2,362	2,465
Electricity	3	3	3	3	4
Natural Gas	2	2	2	2	2
Motor Gasoline	1,295	1,309	1,333	1,335	1,384
Diesel Fuel Oil	658	650	662	698	745
Light Fuel Oil and Kerosene	0	0	0	0	0
Heavy Fuel Oil	68	78	65	67	69
Aviation Gasoline	3	4	4	3	3
Aviation Turbo Fuel	236	215	225	223	246
Propane	16	17	12	12	13
Coal	0	0	0	0	0
Shares(%)	2000	2001	2002	2003	2004
Electricity	0.1%	0.1%	0.1%	0.1%	0.1%
Natural Gas	0.1%	0.1%	0.1%	0.1%	0.1%
Motor Gasoline	56.8%	57.5%	57.8%	56.5%	56.2%
Diesel Fuel Oil	28.8%	28.6%	28.7%	29.5%	30.2%
Light Fuel Oil and Kerosene	0.0%	0.0%	0.0%	0.0%	0.0%
Heavy Fuel Oil	3.0%	3.4%	2.8%	2.8%	2.8%
Aviation Gasoline	0.1%	0.2%	0.2%	0.1%	0.1%
Aviation Turbo Fuel	10.3%	9.4%	9.7%	9.4%	10.0%
Propane	0.7%	0.7%	0.5%	0.5%	0.5%
* year 2004 is the latest year for which data was available Source: Office of Energy http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/tran_ca_1_e_3.cfm					

C. Imports and Exports

The Canadian NEB estimates total crude oil exports at 2.4 million barrels (US liquid) per day, an increase of 217 thousand barrels (US liquid) per day from 2005 levels. According to the Energy Information Administration (EIA), Canada remained the largest export country to the U.S. for crude oil in 2006, ahead of both Mexico and Saudi Arabia.

While Canada is a net exporter of crude oil, much of the requirements of eastern refineries are met with foreign produced crude oil. In 2006, the NEB reported that crude oil imports were 1.1 million barrels (US liquid) per day, which represents 48 % of total refinery feedstock requirements in Canada. Canadian oil production is unevenly distributed across Canada and results in Canada's eastern provinces, where most of the population is located, being net importers. Due to better transportation networks, imports, more than 1/3 of which originated from the United Kingdom and Norway, help meet the requirements for the Atlantic region and Quebec. According to the NEB, Ontario refiners received about 34% of their feedstock requirements from foreign sources in 2006.

Canada remains a net exporter of main petroleum products including middle distillate (heating oil, jet fuel and diesel fuel), heavy fuel oil and gasoline. In 2006, exports of main petroleum products and partially processed oil are estimated at 432 thousand barrels (US liquid) per day, a decrease of 18% compared with 2005. This decrease is attributed to a decrease in refinery production due to outages and maintenance scheduling. In 2006, the

NEB reports that for 2006, Canadian produced petroleum products accounted for about 93 percent of total US petroleum product imports. The NEB estimates that imports of main petroleum products in 2006 stood at 283 thousand barrels (US liquid) per day, a six percent increase form 2005 levels.

4. The Canadian Ethanol Industry

A. Ethanol Production and Distribution Capacities

Based on the trend of net sales of gasoline used for road motor vehicles over the past 5 years (see table 4.1 below), a federal mandate of 5% renewable fuel content would require a minimum of 1.9 billion liters and would require more than doubling Canada's current production capacity of 700 million liters (see table 4.2).

Table 4.1
Sales of Fuel Used for Road Motor Vehicles, Canada; in '000 liters

	2002	2003	2004	2005	2006	Average	05/06
Net sales of gasoline	37,949,600	38,421,608	38,908,671	38,424,100	38,416,021	38,424,000	-0.02%
Net sales of diesel oil	13,737,648	14,720,634	15,671,144	16,216,420	16,594,616	15,388,092	2.33%

Source: Statistics Canada
http://www40.statcan.ca/101/cst01/trade37a.htm

Table 4.2
Fuel Ethanol Production Plant - Existing, Expanding, Under Construction

Status	Location	Company Name	Primary Feedstock	Expected Capacity (million liters)
existing	Varennes Quebec	Greenfield Ethanol*	corn	130
existing	Chatham, Ontario	Greenfield Ethanol^	corn	150
existing	Ottawa, Onatrio	Iogen	straw	2
expanding	St Clair, Ontario	Suncor Energy*	corn	200
existing	Minnedosa, Manitoba	Husky Energy	wheat	10
existing	Lloydminster, Saskatchewan	Husky Energy*	wheat	130
existing	Weyburn, Saskatchewan	NorAmera Bioenergy*	wheat	25
existing	Lanigan Saskatchewan	Poundmaker	wheat	12
existing	Red Deer, Alberta	Permolex	wheat	40
Under construction	Belle Plaine, Saskatchewan	Terra Grain Fuels	wheat	***150***
Under construction	Collingwood, Ontario	Collingwood Ethanol^	corn	***50***
Under construction	Johnstown, Ontario	Greenfield Ethanol*	corn	***200***
Under construction	Hensall, Ontario	Greenfield Ethanol^	corn	***200***
Under construction	Aylmer, Ontario	IGPC^	corn	***150***
Under construction	Minnedosa Manitoba	Husky Energy*	wheat	***130***

* EEP recipients; ^ OEGF Funded projects total: **1,579**
Source: Canadian Renewable Fuels Association

Canadian production is expected to reach 1.579 billion liters by 2009. Suncor is looking into expanding its current facility in St-Clair. This additional production could bring Canada's production capacity up to 1.777 billion liters by 2010. The provinces of Quebec and Ontario

account for 70% of current Canadian ethanol production, with Ontario alone accounting for half of Canadian ethanol production. The remaining thirty percent is taking place in the western provinces of Manitoba, Saskatchewan and Alberta, with Saskatchewan accounting for 24% of the total Canadian ethanol production. The later take-off in the western provinces is in part due to lender fears about using wheat as a feedstock. Ontario and Quebec rely on corn, which is a proven technology. The technological differences of using wheat as a feedstock was enough to retard investment in ethanol production in the western provinces. The expectation of both federal and provincial renewable fuel mandates helped realize investment in wheat-based fuel-ethanol production in the western provinces.

B. Canadian Ethanol Production Business Models

While the federal and provincial programs have been designed to encourage ethanol plants with greater agricultural producer/rural community equity or investment, Canadian ethanol production is being done by companies that range from energy companies and energy marketers, to companies which focus on grain-based ethanol production that often have some degree of producer equity/investment, to co-operatives, to companies focused on a range of activities such as grains, or other sources of renewable fuels. Only one multinational corporation, ADM, has involved itself in the production of Canadian ethanol. ADM has invested in Husky's large wheat-based ethanol production facility in Lloydminster, Saskatchewan. To date, multinationals have not expressed interest in Canadian produced ethanol, seeing Canada primarily as a market for US–produced ethanol. This may change now that the Canadian government has unveiled its new programs and production incentives.

(i) Energy Producer and Marketers

Husky and Suncor

Husky and Suncor are two energy producers and marketing companies which have invested in ethanol production. Husky is a Canadian-based intergated energy and energy related company that operates in the western provinces and off-shore on Canada's east coat. Husky is a pioneer in the production and marketing of ethanol-blended fuel, with its first ethanol plant being built in 1981 in Minnedosa, Manitoba where it produces 10 million litres of wheat-based fuel ethanol. Construction on a new 130 million litre capacity facility on the existing Minnedosa site has begun and is expected to be completed in late 2007. The Minnedosa projet was eligible for 10.4 million dollars from the federal government's EEP. Completion of its newest 130 million litre ethanol plant in Lloydminster, Saskatchewan was completed in late 2006. Husky markets its ethanol blended fuel under the name "Mother Nature's Fuel" at Husky and Mohawk retail outlets.

Suncor, best known for having pioneered commercial development of the oil sands in Alberta, has diversified and become a major North American energy producer and marketer. It opened its St Clair, Ontario plant in July 2006 and blends the ethanol produced into its Sunoco branded gasoline. Suncor is currently studying the feasibility of expanding the production capacity of the St. Clair plant to double its current production capacity that would increase production to 400,000 liters per day.

(ii) Grain Based Ethanol Plants with Producer Equity

GreenField Ethanol

Many of the Canadian ethanol plants have some producer equity due in large part to government programs that require a percentage of producer investment in order to be eligible for federal funding. GreenField Ethanol's (formerly known as Commercial Alcohols)

first plant was in Chatham, Ontario and was started by a group of local producers who still have an equity position in GreenField. Today it has 2 fuel-ethanol plants in operation and 2 more in the process of being built. The plant in Chatham, Ontario is currently the largest ethanol facility in Canada, producing 150 million liters of fuel ethanol per year in addition to a range of ethanol products including industrial and beverage alcohol.

GreenField's newest plant, located in Varennes Quebec was launched at the end of June 2007 and is Quebec's first fuel ethanol plant. The plant's feedstock will be purchased through Pro-Ethanol, a group of 500 Quebec corn farmers who have invested in the plant. The plant has an operating capacity of 130 million litres of ethanol. The construction of the Varennes plant was financed in part by the federal government's Ethanol Expansion Program (EEP; $18 million $CAN). Petro-Canada, a Canadian oil and gas company, has already purchased all of the ethanol that the plant will produce for the next 10 years. In addition to producing fuel grade ethanol, the plant will also produce carbon dioxide (CO2) and Dried Distillers Grain (DDGs).

GreenField Ethanol plans to make available a similar producer investment opportunity to Hensall District Co-op, one of Canada's largest agricultural co-ooperative, to invest in its Hensall fuel-ethanol project. It also welcomes Seaway Valley Co-operative investors of the failed Cornwall project to invest in the Johnston project. Plants under construction in Johnston and Hensall, Ontario are expected to be in operation in 2008. Both plants will have a production capacity of 200 million litres and produce fuel-grade ethanol, CO_2 and DDGs. The Johnstown plant was a EEP receipient (15 million $CAN).

Pound-maker

Pound-maker began in the 1970's as a feedlot by local area farmers looking for alternative markets for their grain. A 10,000 head feedlot and a 10 million-liter ethanol plant were constructed in 1991, making it Canada's first integrated ethanol plant/feedlot. Ethanol production has increased to 12.5 million liters with technological improvements. The plants by-products are thin stillage and wet distillers grains, both of which are used in the feedlot.

Terra Grains

Terra Grains is a privately held company with a number of Saskatchewan producers among the investors. It is expected to use approximately 15 million bushels of wheat annually and produce 150 million liters of ethanol and 165,000 tons of DDGs. Startup is anticipated for December 2007.

IGPC (Intergated Grain Processors Co-operative)

IGPC, an 840 farmer and community member co-operative, began construction in June 2007 after being granted a 100 million dollar loan package. The community-owned ethanol plant is the largest start-up co-operative venture ever attempted in Canada. IGPC is putting 70 million $CAN of equity into the project and was granted 11.9 million $CAN in support from the federal Ethanol Expansion Program, and a 14 million $CAN capital grant from the Ontario Ethanol Growth Fund.

(iii) Renewable Energy Companies

NorAmera

NorAmera BioEnergy Corporation (NABEC) is a privately held company founded to produce renewable energy, and is considered a small player relative to other major ethanol

production companies in Canada. Located in Weyburn, Saskatchewan, NorAmera converted a long-defunct Weyburn distillery into a state-of-the-art ethanol plant valued in excess of 20 million $CAN. The plant produces 25 million liters of ethanol a year.

Permolex

Permolex International is an emerging global leader in the production of ethanol and other bio-fuel products from multiple feedstock. Its plant in Red Deer, Alberta was the first of its kind in North America using feed-grade wheat in its initial stages of production. The plant integrates three traditionally independent manufacturing processes – a flour mill, a gluten plant, and an ethanol plant and as a result is one of the largest users of the Canadian Prairie Spring (CPS) wheat variety in Canada. The CPS wheat is sold to Permolex either through the CWB or at spot market prices. The fuel ethanol plant uses the wet mill process.

Iogen

Based in Ottawa, Ontario, Iogen is a biotechnology firm that has pioneered the world's first demonstration-scale facility to convert cellulose material such as wheat straw into bio-ethanol using its patented enzymes manufactured in an adjacent enzyme manufacturing facility. Iogen calls its product EcoEthanol. Although Iogen has received some public funding, most of its financial backing comes from private companies. Much of its ethanol research is funded through the sale of its industrial-use enzymes. Iogen has plans to build several full-scale commercial plants in the future, but has need of a government entity as a loan guarantor.

5. The Canadian Bio-diesel Industry

A. Bio-diesel Production and Distribution Capacities

Based on the trend of diesel fuel sales in the last three years, a federal mandate of 2% renewable fuel content in diesel fuel would require a five-fold increase in current production capacity. Canada consumes approximately 26 billion liters of diesel fuel a year and the demand for diesel fuel is expected to increase and even outpace that of other fuels in 2007/2008[1]. Despite being higher priced, diesel fuel is growing in demand as retail consumers start to take notice of the efficiency and durability of diesel engines.

The 2% mandate would require 520 million liters of bio-diesel. While Canada's bio-diesel production grew rapidly in the past year, with production capacity growing from 9 million liters to almost 100 million liters in 2007/2008 due to the opening and expansion of new facilities, future growth may be limited the industry's ability to secure cheap feedstock. Most of the current and forecasted increase in bio-diesel comes from rendered animal by-products and industry sources put a ceiling on potential production from rendered animal fats at 250 million liters. High prices for oilseeds and limited crushing capacity in Canada may hinder Canada's ability to supply the majority of the feedstock necessary for the balance of the volume required. Crush capacity has increased in 2006/2007 with James Richard International and Louis Dreyfus Canada announcing the construction of large-scale crushing facilities.

The federal government's new bio-fuel strategies programs are geared more towards ethanol and are therefore limited in their ability to address the limiting factors for bio-diesel market

[1] Petroleum Product Market Outlook – May 2007, natural resources Canada; http://fuelfocus.nrcan.gc.ca/reports/2007-06/supply_demand_e.cfm

growth. For example, crushing plants can be used to produce oil for both bio-diesel production and human consumption, but the federal government does not want to inadvertently subsidize crushing capacity for oils destined for human consumption. Many investors, seeing the potential for bio-diesel, hope to cash in on the federal government's ecoABC Initiative, a program to assist in the construction of bio-fuel facilities that have a minimum of five percent producer investment. The Saskatchewan Bio-diesel Development Council raised a red flag when it warned bio-diesel proponents that crushing components of bio-diesel ventures would not be eligible for the repayable contributions. The Saskatchewan Bio-diesel Development Council is frustrated by this, arguing that this violates the equity in support that is supposed to exist between ethanol and bio-diesel.

Table 5.1
Bio-diesel Production Plants (Current, Expanding, Under Construction)

Status	Location	Company Name	Feedstock	Capacity (million liters)
Existing	Foam Lake, Saskatchewan	Milligan Bio-tech	canola oil	1
Existing	Montreal, Quebec	Rothsay	tallow	30
Existing	Hamilton, Ontario	BIOX Corporation	tallow, yellow grease, palm oil	66
			sum:	97

Source: Canadian Renewable Fuels Association

B. Canadian Bio-diesel Production Business Models

Miiligan Biotech

Milligan Bio-Tech was started by a small group of entrepreneurs working in conjunction with the local Marketing Club, the Saskatchewan Canola Development Commission, Agriculture Canada, the University of Saskatchewan and Saskatchewan Growers Association. The company is largely research and development focused. The original purpose was to develop and demonstrate how canola could be used to make the highest quality of bio-diesel. A series of pilot projects have been conducted to test the efficiency of canola-based bio-diesel (for example Saskatoon Transit's Bio-Bus project). In 2006, a crushing plant to generate the oil used for the production of bio-diesel and co-products was constructed in Foam Lake.

Rothsay

Rothsay is a division of Maple Leaf Foods Incorporated, a meat company. In late 2005, it opened its first commercial–scale bio-diesel plant. The facility has a commercial capacity of 35 million liters annually. Maple Leaf, through Rothsay, has been working to foster the bio-diesel industry in Canada and has been involved in pilot projects designed to test the efficiency of bio-diesel such as the city of Montreal's Bio-Bus and BioMer.

BIOX Corporation

Biox is a multinational that was incorporated in Canada in 2001. Its goals are global and it structures partnerships with both companies and individuals. Its goal is to produce ASTM D6751-07 and EN 14214 grade bio-diesel from a variety of feedstocks such as vegetable oils,

agricultural seed oils/greases or waste from animals fats. Its 1 million liter pilot plant was opened in Oakville, Ontario. In late 2006, BIOX completed construction and commission of its first commercial-scale bio-diesel demonstration facility that produces 60 million liters per year.

5. Import Regimes for Bio-Fuels

There is no tariff on renewable fuels produced in the United States and imported into Canada, however, Canada does have a tariff on ethanol imported from Brazil ($0.05 per liter).

While the current differences in provincial tax exemptions do not greatly affect production decisions, a combination of lower oil prices (should we return to pre-2005 levels), and higher grain prices could make certain provincial tax-exemption restrictions obstacles to expanding the industry.

6. The Economics of Bio-fuel Production in Canada

The long-term viability of producing bio-fuels in Canada will depend on a multitude of factors including size, production types, co-products, feedstock costs, and energy prices. The required increase in bio-fuel production set out by the federal mandate will likely necessitate a movement away from food and grain crops to growing crops for industrial purposes and have a significant impact on agriculture, as it will affect other grains, livestock, and agricultural land values.

A. Factors Affecting the Long-term Viability of a Canadian Bio-fuel Industry

A multitude of studies have been conducted on the cost of production for different plant sizes for ethanol production. Economic studies conducted in the US have shown that there are large economies of scale in bio-fuel manufacturing. It was estimated that tripling of a plant size reduced capital costs by 40% and operating costs by 15-20%. All new Canadian ethanol plants under construction, with the exception of Collingwood Ethanol, are all large-scale facilities designed to capture these economies of scale. The eligibility limits outlined by the federal government production program is 200 million liters per year, production limits that Canadian plants currently are below.

While ethanol tends to follow the trends of petroleum prices, ethanol is not a primary energy source. It requires energy to make this type of energy and many critics maintain that it takes more energy to produce ethanol than is derived from ethanol. The total effect of ethanol as a gasoline substitute is unclear. On a gallon per gallon comparison, the energy balance is negative - you travel less far on a liter of ethanol than a liter of gasoline. Proponents of ethanol production argue that technological advances have led to better conversion ratios and that additional opportunity costs from the entire fuel cycle must be factored in. This argument has lead to an increased interest in the co-products of ethanol production.

Interest in the value of co-products has increased, due to their use in reducing per gallon costs of production for ethanol. Different milling processes produce different co-products. Wet milling processes can also produce corn oil, corn gluten meal, corn gluten feed, and carbon dioxide. Canada's smaller and earliest ethanol plants are wet milling plants. These plants, however, only produce wet distillers grains as co-products, since they do not meet the economies of scale needed to warrant the production and marketing of the other potential

co-products. These plants produce wet distillers grains that are consumed by local cattle. Potential for large-scale wet milling plants is limited as the large cattle and dairy production does not take place in areas close to the ethanol plants. It is for this reason that Canada's large scale plants are dry-milling plants for which the by-products are distillers dried grain, condensed syrup, and carbon dioxide. By drying the DDGs, it is possible to market this feed substitute to livestock markets that are further away. Possible market intervention by the Canadian Wheat Board may limit a plant's ability to extract full value for its co-product. Additional limiting factors for extracting full value from the co-products and ethanol itself is a lack of efficient distribution channels and infrastructure.

Infrastructure and shipping logistics of feedstocks, fuel-ethanol and its co-products are also factors that will affect Canadian competitiveness. With most refineries and most of the populations in the east, and much of the increase in production capacities occurring in the west, infrastructure and distribution issues become increasingly important. Industry sources see the short to medium term impact to be increased rail usage. Proximity to railways has been important when choosing a location for an ethanol plant. Ethanol feedstock, ethanol and ethanol co-products will however have to compete with other, perhaps higher priced goods. In recent years, the two major railways in Canada have been facing increased criticism for poor rail services for agricultural goods. Rail connections with neighboring US states may also increase. Overseas deliveries of dried distillers grains is being done via vessels and therefore necessitates getting the co-products to the coastlines.

The ability to compete with petroleum will be affected as the profit margin for ethanol production has been narrowing due to increases in natural gas prices (an energy requirement in dry milling ethanol production), as well as to increases in feedstock costs due to price increases in fertilizers, and on-farm fuel. According to Agriculture and Agri-food Canada (AAFC), fertilizer prices in 2006 reached record highs, a trend that is expected to continue to increase in 2007[2]. Fuel and fertilizer account for 15% of Canadian farm expenses. AAFC predicts that the increasing demand for bio-fuels will continue to force fertilizer prices upwards since the bio-fuels demand is altering production patterns and resulting in increased crop production of the type that require large amounts of fertilizer. AAFC predicts that this will drive the prices for fertilizer up by 3.8% in 2007. Canadian farmers will be receiving some help to deal with rising costs. The federal government has promised a one-time direct payment of $400 million to producers this year to help address high production costs over the last four years, and $100 million annually to address cost of production issues when they occur.

B. Impacts of Ethanol Production on Feedstock Markets

Corn and wheat are the main feedstock for ethanol production in Canada and the introduction of the renewable fuel content by the Canadian government will undoubtedly have an impact on production patterns. At this time, there are no official statistics for the amount of corn and wheat directed into ethanol production. Table 6.1 on the following page provides estimates and forecasts on the quantity of corn and wheat that has and will be directed into ethanol production. These estimates are based on plants' production capacities and when plants, current and those being constructed, have or are expected to come on line.

[2] http://www.agr.gc.ca/mad-dam/index_e.php?s1=pubs&s2=bi&s3=php&page=bulletin_20_05_2007-03-30

Table 6.1 Quantity of Feedstock Used in Ethanol Production*; in MT							
	2003	2004	2005	2006	2007(f)	2008(f)	2009(f)
Corn	320,000	360,000	560,000	635,000	1,054,100	1,854,200	2,806,700
Wheat	150,000	150,000	150,000	189,416	472,452	940,550	1,082,068
*estimates; conversion factors: 1 bushel of corn or wheat = 10 liters of ethanol 1 bushel corn = .0254 MT 1 bushel of wheat = .021772 MT							

(i) Ethanol Produced from Corn

The province of Ontario is the largest corn-producing province in Canada and, not surprisingly, where 50% of the Canadian ethanol production takes place. Corn at this time, is the main feedstock for Canadian ethanol production. Corn production also takes place in the province of Quebec (see table 8.2 at end of report).

Table 6.2 Quantity of Corn Used for Feed, Ethanol Production; in TMT					
	Domestic Corn Production	Corn Imports[1]	Corn Imports[2] from US	Corn for Feed[3]	Corn for Ethanol[4]
2003	9,587	3,732	3,726	9,500	320
2004	8,837	2,101	2,098	7,951	360
2005	9,361	2,143	2,139	8,297	560
2006	8,990	1,886	1,881	8,400	635
2007(f)	11,400	1,665	1,600	8,700	1,054
[1,2] import data based on a calendar year, all corn excluding popping corn; source: Statistics Canada [3,4] no official statistics exist, estimates based on production in a calendar year					

Corn is estimated to account for 77% of the feedstock used in ethanol production in Canada in 2006. In 2007 and 2008 it is expected to account for 69% and 66% of ethanol feedstock, respectively, as more wheat-based ethanol plants come on-line. In 2006, it is estimated that 635 thousand metric tons (TMT) of corn was directed into ethanol production. In 2007, it is estimated that 1,054 TMT of corn will be directed towards ethanol production, a 66% increase from 2006 levels. In response to the increased demand from the ethanol industry and high grain prices, Canadian agricultural producers in Ontario and Quebec planted record amounts of corn in the spring of 2007. Canada is forecast to produce 11.4 million metric tons (MMT) of corn in 2007, a 27% increase over 2006 levels, and to import 1.665 MMT, mainly from the US. The forecasted decrease in corn imports is due to higher levels of domestic supply. With the forecasted expansion of the corn-based ethanol industry in 2008, the amount of corn required to meet production needs in 2008 is an estimated 1.9 MMT (see table 6.1), which represents a 76% increase over 2007 demand.

The increase in demand for corn by the ethanol plants, and Canada's limited corn-production capacity due to climatic factors will result in the feed and ethanol industry in Canada competing for corn. Many analysts say that this reduction in corn availability could be met

with the ethanol by-product of dried distillers grains. The Canadian livestock industry disagrees and has been very vocal on this issue, pointing to increases in feed costs as a reason for lower livestock output. Other private industry sources reject this reasoning, arguing that if the livestock industry were healthy prior to the feed price increases, the livestock industry would simply pass on the cost to consumers. This has not been possible as the Canadian livestock industry is having trouble regaining its international beef markets in the post-BSE era. Industry sources also point to structural problems in the domestic pork packing industry as Canadian pork packers struggle to remain competitive in an ever increasingly competitive world market for pork. In addition, the strengthening Canadian dollar continues to pressure Canadian meat exports on the international scene and this comes back to gnaw at producers via lower bid prices by domestic packers. Any shortfall in the ability to meet demand for corn domestically due to the re-direction of corn into ethanol use and away from feed will likely be met by US imports of corn. However, the volume of potential increases in US corn imports will be mitigated by a shrinking Canadian livestock industry (and therefore a reduced demand for feed), the untapped corn growing capacities in Ontario and Quebec, high corn prices, and the ability to use feed corn substitutes for such as barley and DDGs.

There are concerns, however, that the demand for corn will crowd out the production of other crops and that producers will forgo the traditional corn-soybean rotation in order to take advantage of the market conditions. In addition, policy measures have been put in place that encourage the production of corn. For example, while the costs of production have increased significantly, and could influence planting decisions away from corn, the federal government has introduced funding to mitigate the impact of these increases. While theoretically, increased corn costs also narrow the profit margins for corn-based ethanol production and could slow down production, federal production incentive programs and some provincial programs mitigate increases in inputs costs for ethanol production.

(ii) Ethanol Produced from Wheat

Wheat is the feedstock for most of the remaining 23% of Canada's ethanol production in 2006 and is expected to make up a consistently greater share of the ethanol feedstock as more wheat-based ethanol plants come on-line. Unlike corn, Canada produces ample quantities of wheat, which could be used to meet ethanol production expectations.

Table 6.3
Quantity of Wheat Used for Feed, Ethanol Production; in TMT

	Domestic Wheat Production	Wheat Imports[1]	Wheat Imports[2] from US	Wheat for Feed[3]	Wheat for Ethanol[4]
2003	23,500	50	24	3,300	150
2004	25,860	14	14	5,056	150
2005	26,775	18	17	5,056	150
2006	25,265	27	25	4,800	189
2007(f)	22,140	22	19	4,500	472

[1,2] import data based on a calendar year and includes only HS code 1001; source: Statistics Canada
[3,4] no official statistics exist, estimates based on production in a calendar year

As shown in table 6.3, in 2007, it is estimated that 472 thousand metric tons (TMT) of wheat will be directed towards ethanol production, a one and a half time increase from 2006 levels. Canada is forecast to produce 22.1 MMT of wheat in 2007, a 12.4%% decrease from 2006 levels. By 2008, the openings of wheat-based ethanol plants in Western Canada will increase the demand of wheat destined for ethanol production to 941 MMT (see table 6.1), which represents a nearly 100% increase over the estimated 2007 wheat demand for ethanol of 472 MMT.

As the ethanol industry grows, demand for different wheat varieties is also expected to grow resulting in increased competition between wheat end-users, such as the Canadian ethanol producers, livestock producers and the needs of the milling industry. The need for high-yielding, low-protein wheat by the livestock industry and the ethanol plants are in direct conflict with the needs of the flour industry. Increases in ethanol efficient wheat is expected to affect production patterns and result in more Canadian wheat farmers seeding area to lower protein/high starch wheat such as Winter Wheat and Canadian Prairie Spring Wheat rather than higher protein/lower starch wheat varieties used by the milling industry. The livestock sector, especially the hog sector, competes for the same wheat varieties as the ethanol sector. There are additional layers of complication when using wheat as a feedstock in ethanol production, depending on the co-products produced and the markets for which they are destined. The Canadian Wheat Board (CWB) controls the sales of wheat for human consumption and export and therefore as long as the ethanol is going to be used as fuel and the DDG's are going to be fed to livestock, the CWB has no involvement. If the plant fractionates the grain to create by-products that can reduce the cost of production for each liter of ethanol, and it removes components that can be used for human consumption such as wheat gluten, then a portion of the wheat technically, has, to be purchased through the CWB. For the most part, ethanol plants purchase their wheat in the same way a feed mill does, either directly from farmers or from a grain company. While the CWB promotes industrial uses for its western-grown grains, its current position is that although its mandate allows it to enter the market for sales of wheat for ethanol production, it will not do so.

(iii) Ethanol Produced from Sugercane or Sugar Beets

Canada does not produce ethanol from sugarcane or sugar beets, nor are there any expectations that it will.

C. Impacts of Bio-Diesel Production on Feedstock Markets

(i) Bio-Diesel Produced from Canola and Animal Fats/Oils

With a 2% bio-diesel mandate in place, the choice of feedstock comes into question. While bio-diesel can be made from a variety of feedstocks, feedstock prices and availability are the determining factors of which one will be used. While canola, due the abundance of the Canadian production, was thought to be the natural choice for feedstock, recent studies suggest that this is unlikely with a 2% bio-diesel mandate. Key competitors facing canola oil for use in bio-diesel are rendered oils (yellow grease), rendered animal fats (tallow), palm oil (which would be imported as Canada does not produce palm oil), and soybean oil. Canola and soybeans are high priced feedstock for bio-diesel since they are priced as food oils in the international markets while palm oil and rendered fats are priced at feed and industrial use levels.

Table 6.4 illustrates the consumption of feedstock by Canada's nascent bio-diesel industry.

Table 6.4
Quantity of Feedstock Used in Bio-diesel Production*; in million liters

	2003	2004	2005	2006	2007(f)
Soybean oil	0	0	0	0	0
Rapeseed Oil	0	0	0	0	0.99
Palm Oil	0	0	0	0	18
Animal Fats	0	0	0	35	35
Recycled Vegetable Oil	0	0	0	0	42
Conversion factor: 1 liter feedstock = 1.10 liters bio-diesel					

Canola production has reached record high levels in recent years, and increased demand from canola oil for use as a healthy oil in the food retail industry has resulted in higher prices making it a prohibitive choice for use in bio-diesel. It remains to be seen whether or not a 2% bio-diesel blend can be met solely with current supplies of the cheaper feedstocks, but industry information suggests that it can. As the demand for the cheaper feedstocks increases, so will their prices. This may result in canola being used to fill the void created in various markets such as the soap and chemical markets. Industry information indicates that a demand for 503 million liters of bio-diesel demand could and will likely be met using feedstocks that come from yellow grease and palm oil. Canola oil use would remain mainly for food, with some going into soap and chemical production and feed and an even smaller amount going for export. In addition, canola may be used as an additive to bio-diesel to help improve the flow and storability issues that often complicate bio-diesel production. Soybeans would be used exclusively for food use and tallow would be reallocated from feed use into bio-diesel.

D. Fuels Produced from Other Bio-Mass

Canada does not produce significant quantities of bio-fuels from other plant matter. Iogen does operate an Ontario plant, which produces cellulosic ethanol mainly from straw and has an annual production capacity of approximately 1 million liters. It plans to build several full-scale commercial plants in the future. It has financial backing from private companies, but has need of a government entity as a loan guarantor.

E. Potential Trade Impacts

As Canada continues to build its bio-fuel production capacity through its diverse federal and provincial programs/strategies, potential trade issues such as World Trade Organization disciplines, biotechnology, and inter-provincial barriers that are contrary to the national treatment principle embodied in the WTO and the NAFTA may present policy complications.

Provincial incentives that create trade barriers by having only ethanol produced from feedstock produced in-province may face increased scrutiny as they violate the national treatment embodied in the WTO and NAFTA as they are barriers to trade.

These concerns are likely still a long ways off as an international trade/market for ethanol and bio-diesel has yet to develop. In the meantime, Canada will be concentrating its efforts on building up the industry.

The possibility of significant volumes of ethanol trade, especially between the northwest U.S. and Western Canada (wheat-ethanol to the United States and corn-based ethanol to Canada), is unlikely to develop in the short to medium term. This is due mainly to the fact that Canada does not have excess ethanol production capacity, which would permit exports being shipped to the United States. In addition, the transportation, distribution and infrastructure issues around ethanol trade have yet to be resolved.

No official trade statistics exist for either fuel ethanol or bio-diesel trade. However, industry statistics suggest that Canadian imports of fuel ethanol are exclusively from the US, and for the 2002-2007, these imports have hovered around 70-100 million liters a year. Canada does, however, provide trade statistics for industrial ethanol. The bulk of industrial ethanol trade (HS 22.07.10 and 22.07.20) takes place with the United States (see table 6.5a,b). In 2006, Canadian exports of denatured alcohol (ethanol that cannot be used for beverages nor for hospital use) nearly doubled from the previous year's levels, jumping from 18.8 million liters pure alcohol (MLPA) to 37.5 MLPA. This jump in exports in reflected in exports of denatured alcohol, which jumped from 13.8 MLPA in 2005 to 32.2 MLPA in 2006.

Table 6.5a

Canada Ethanol Exports (2003-2006); in '000 Liters Pure Alcohol

HS code	Description	2003	2004	2005	2006
	Total Ethanol	19,678	29,340	35,439	57,413
220710	Undenatured	8,382	11,008	16,606	19,957
220720	Denatured	11,296	18,332	18,834	37,457

Source: World Trade Atlas, Statistics Canada

Table 6.5b

Canada Ethanol Exports to U.S. (2003-2006); in '000 Liters Pure Alcohol

HS code	Description	2003	2004	2005	2006
	Total Ethanol	17,493	22,867	23,703	40,698
220710	Undenatured	6,965	9,037	9,867	8,460
220720	Denatured	10,528	13,830	13,836	32,238

Source: World Trade Atlas, Statistics Canada

Table 6.6a

Canada Ethanol Imports (2003-2006); in '000 Litres Pure Alcohol

HS code	Description	2003	2004	2005	2006
	Total Ethanol	140,012	156,242	152,058	100,325
220710	Undenatured	34,897	35,993	29,397	34,782
220720	Denatured	105,115	120,249	122,661	65,543

Source: World Trade Atlas, Statistics Canada

Table 6.6b

Canada Ethanol Imports from U.S. (2003-2006); in '000 Litres Pure Alcohol

HS code	Description	2003	2004	2005	2006
	Total Ethanol	125,655	135,463	113,536	78,379
220710	Undenatured	21,448	33,361	21,809	26,385
220720	Denatured	104,207	102,101	91,726	51,994

Source: World Trade Atlas, Statistics Canada

As illustrated in table 6.6a,b on the previous page, Canadian imports of denatured ethanol showed the reverse trend with imports dropping in 2006. Imports of denatured ethanol dropped to 65.5 MLPA in 2006 from 122.7 MLPA in 2005. Again, this is reflected in the decrease of imports from the U.S., which dropped to 52.0 MLPA in 2006 from 91.7 MLPA in 2005.

7. Conclusion

The federal government's bio-fuel strategy will result in increased bio-fuel production capacity in Canada. However, Canada's ability to compete in grain-based ethanol production with the U.S. or low cost production countries without government subsidies and market intervention is limited. The long term-viability of the Canadian bio-fuels industry will depend on a multitude of factors including size, production types, co-products, feedstock costs, and energy prices. The required increase in bio-fuel production required by the federal mandate will result in a movement away from food and grain crops to growing crops for industrial purposes and will have a significant impact on agriculture, as it will affect other grains, livestock, and agricultural land values. Cellulosic ethanol provides the best means of achieving the objectives of the Canadian bio-fuel mandate, but the rate at which this technology will take to commercialize remains unknown.

Better trade statistics are needed to measure the trade developments of the bio-fuels market and the markets for the co-products. Canada's limited production capacity, both in the short and medium term suggests that Canada's entry into the global ethanol market is still quite distant. While the possibility of increased ethanol trade, especially between the northwest U.S. and Western Canada (wheat-ethanol to the United States and corn-based ethanol to Canada), is unlikely to develop in the short to medium term, there is an increasing amount of trade taking place in the co-products of ethanol production.

8. Additional Figures/Tables

(see next page)

Figure 8.1: Map of Canadian Bio-fuel Production Capacity

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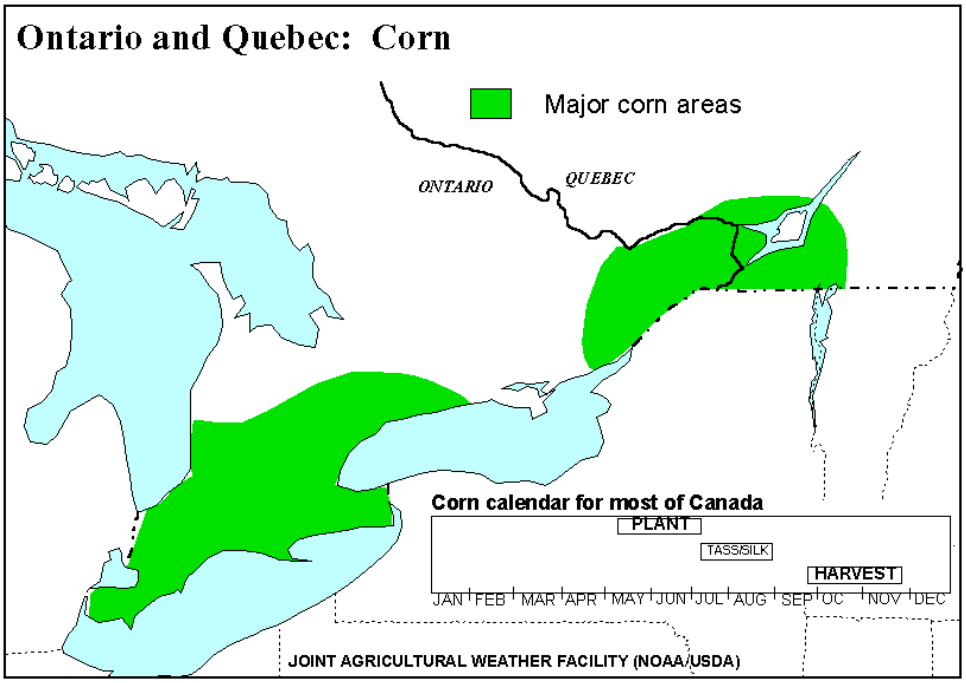
Figure 8.2: Corn Growing Regions in Canada



Source: FAS, USDA

Table 8.1
Quantity of Feedstock Use in Ethanol and Bio-diesel Production; in MT

		2003	2004	2005	2006	2007(f)
Ethanol						
	Corn	320,000	360,000	560,000	635,000	1,054,100
	Wheat	150,000	150,000	150,000	189,416	472,452
Bio-diesel						
	Soybean oil	0	0	0	0	0
	Rapeseed Oil	0	0	0	0	908
	Palm Oil	0	0	0	*na in MT*	*na in MT*
	Animal Fats	0	0	0	*na in MT*	*na in MT*
	Recycled Vegetable Oil	0	0	0	*na in MT*	*na in MT*

Conversion factors 1 bushel of wheat or corn = 10 liters of ethanol
1 bushel corn = .0254 MT
1 bushel of wheat = .021772 MT
Conversion factor 1 liter bio-diesel = .880 kg bio-diesel
Conversion factors 1 liter feedstock = 1.01 liters bio-diesel
Conversion factors for canola: 1 liter canola oil weighs .0917 kg

Table 8.2
Bio-fuel Production/Consumption/Trade (million liters)

	2003	2004	2005	2006	2007
Bio-diesel/ethanol					
Beginning stocks	0	0	0	0	0
Production	195	211	289	372	728
Imports*	0	0	0	0	0
Total supply	195	211	289	372	728
Exports*	70	70	100	100	0
Consumption	165	141	189	272	728
Ending Stocks	0	0	0	0	0

*No official trade statistics exist for either fuel ethanol or bio-diesel trade; based on industry information