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Canada as an Investment Destination for Biofuels

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Prepared by: Investor Services Division (BIS)

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Introduction

Currently there exists multiple ways of producing electricity from renewable sources, these include technologies such as wind, hydro, biomass, tidal and solar. Most of these renewable sources of electricity (notably wind power) can compete profitably with traditional sources of electrical generation without the need of subsidies.

Unfortunately electricity cannot run airplanes, large cars, trucks and long distance shipping due to limitations in battery and electric engine technology. Currently only liquid fuels can achieve this goal.

However when it comes to liquid fuels there exists relatively few ways of producing an alternative to non-renewable sources including gasoline, distillates (diesel and heating oil) and compressed natural gas.

Currently there exists only two alternative ways of producing a liquid transportation fuel including biofuels and hydrogen. At the current time hydrogen can be produced from natural gas which is a non-renewable source or it can be produced via electricity which is very inefficient. Biofuels are currently the only known economical way of producing a renewable liquid fuel.

Why Develop Biofuels?

Environmental Concerns

Biofuels are also an important tool in a bid to combat the challenge of global warming. The Canadian Government is committed to reducing greenhouse gases. The lower carbon footprint of biofuels relative to crude oil can allow Canada to meet its commitment under the Kyoto Protocol. Furthermore some biofuels such as biogas from landfills (used to generate power and heat) can remove pollutants and odours from the air creating cleaner communities in the process.

Energy Security

Out of all the members of the G20, Canada has the highest per capita consumption of petroleum; as such, petroleum plays a crucial role in the functioning of the Canadian economy.

Even though Canada has been endowed with the 2nd largest reserve of crude oil in the world (including oil sands sources), the design of Canada's pipeline system makes Canada very vulnerable to a potential disruption in crude oil supplies. All excess supplies west of Ontario are currently transported via pipeline to the United States. All provinces east of Manitoba get most of their crude oil supplies from foreign sources. As such these provinces are vulnerable to potential disruptions in supplies. Using biofuels can help increase Canada's energy security.

What are Biofuels?

Biofuels are solid, liquid or gaseous fuels which originate from relatively recently lifeless or living biological material. In contrast, fossil fuels are derived from long dead biological material. Many different types of plants and plant-derived materials are used for biofuel manufacturing including (i.e. corn, sugar cane, canola, biological waste).

What is Grain Ethanol ?

Grain Ethanol is a liquid alcohol obtained from the fermentation of sugar or converted starch contained in grains and other agricultural or agri-forest feedstocks. In Canada, ethanol is presently made principally from corn and wheat. Ethanol can be produced for different applications, for example, industrial ethanol or fuel grade ethanol.¹

What is Biodiesel?

Biodiesel is a non-toxic and biodegradable fuel made from vegetable oils, waste cooking oil, animal fats or tall oil (a by-product from pulp and paper processing). Biodiesel is produced from

¹ Natural Resources Canada, <http://oee.nrcan.gc.ca/transportation/fuels/ethanol/ethanol.cfm?attr=8>

these feedstocks through a process called transesterification, by reacting the oil with an alcohol (usually methanol, although ethanol can also be used) and a catalyst (such as sodium hydroxide).² The resulting chemical reaction produces glycerine and an ester called biodiesel.²

What is Cellulosic Ethanol?

Cellulosic Ethanol is a next-generation renewable fuel produced from lignocellulose which is derived from non-traditional renewable feedstocks, such as fast-growing grasses (e.g. switchgrass), agricultural residues (e.g. corn stover and hay) and forest biomass (e.g. wood chips). Such cellulosic feedstocks are in abundance and consist largely of materials that are currently considered waste, can often be grown on low-grade soil, and have greater potential for co-products (e.g. acetic acid or acetate). However cellulosic ethanol requires a greater amount of processing to make the sugar monomers available to the microorganisms that are typically used to produce ethanol by fermentation.

What is BioGas/SynGas?

BioGas is the gas produced from the decomposition of organic material (e.g. livestock manure and dead plants) in an anaerobic digester consisting of 60-80 percent methane (which is the main component in natural gas), 30-40 percent carbon dioxide, and other trace gases such as hydrogen sulfide, ammonia and hydrogen.³ The methane can be burned directly for the production of heat or for heat and power.

Syngas is produced from a chemical/thermal conversion (high temperature combustion in an enclosed container) of wood or cellulosic biomass. Because the inputs and technology to produce biogas and syngas are different the resulting gas output is also different. Using the latest technology transportation fuels can be obtained using wood syngas, but methane is a less concentrated fuel it is better suited for other purposes.⁴

Biofuels Industry in Canada

Ethanol Industry in Canada

In January of 2009, Canada had 15 ethanol plants producing 1340 million litres per year (MML/y), primarily using corn as a feedstock. However, there is an increasingly growing amount of ethanol using wheat as a feedstock. There currently are 4 ethanol plants under construction, when completed by late 2010 these plants will bring total Canadian ethanol production to 1681 MML/y. In addition, Suncor is contemplating doubling the size of its St. Clair Ontario plant and if they proceed with the project, total Canadian ethanol production can reach 1881 MML/y.

Under the 5% national renewable fuel standard passed by the federal government in July 2008 under bill C-33, the amount of ethanol in the gasoline pool by 2010 ethanol production would have to grow to over 2000 MML/D. However demand for ethanol will be higher than 2000 MML/D by 2010 as some provinces have mandated higher renewable energy content for gasoline. Manitoba's ethanol mandate requires fuel suppliers in Manitoba to replace at least 8.5% of their gasoline available for sale with ethanol. In addition, fuel distributors in Saskatchewan are currently required to blend 7.5 percent ethanol into their total gasoline sales.

Owing to environmental concerns, the province of Quebec has mandated that lignocellulosic based ethanol be used for future ethanol production.

Biodiesel Industry in Canada

In January of 2009, Canada had 6 biodiesel plants producing 126 million litres per year (MML/Y), primarily from waste feed stocks. There currently are 5 biodiesel plants under construction, when completed by late 2010 these plants will bring total Canadian biodiesel production to 456 MML/D.

The 2% national renewable mandate for diesel and heating oil by 2012, legislated by the federal government would require additional increases in production capacity to 520 million litres per year. However, expansions could be limited by the industry's ability to secure low-cost feedstock.

² Natural Resources Canada, <http://oee.nrcan.gc.ca/transportation/fuels/biodiesel/biodiesel.cfm?attr=8>

³ PennState, College of Agricultural Sciences, <http://www.biogas.psu.edu/terminology.html>

⁴ Alberta SRD, 2009, <http://www.srd.gov.ab.ca/forests/bioenergy/default.aspx#q6>

Most of the projected increases in production are from rendered animal by-products, and industry sources put a ceiling on potential production from rendered animal fats at 250 million litres. Any additional capacity would have to come from oilseeds, however high prices and crushing capacity may limit production from this feedstock, so imported palm oil may be used.

Cellulosic Ethanol Industry in Canada

Since the 1970's the cellulosic ethanol industry has been mostly concentrating on R&D. Due to strides in technology the cellulosic ethanol industry is now just starting to enter the commercialization stage.

Iogen Corp. has built the world's first and only demonstration-scale cellulosic ethanol facility in Ottawa, Ontario to convert biomass to cellulose ethanol using enzyme technology. The plant was designed and engineered to process 40 tons per day of wheat straw using enzymes made in an adjacent enzyme manufacturing facility.

On June 2nd 2009, Iogen Corp. announced it has reached a preliminary deal with Domtar Corp. and the Saskatchewan government to convert a pulp mill in Prince Albert into a cellulosic ethanol plant and bio-energy facility. The project is said to be a first-of-its-kind facility converting cereal straw to cellulosic ethanol, a low-carbon fuel that can be used in today's cars. When construction starts on the project in spring 2010 it will also involve the construction of a \$250-million power plant that produces green energy from forest and ethanol plant residues.⁵

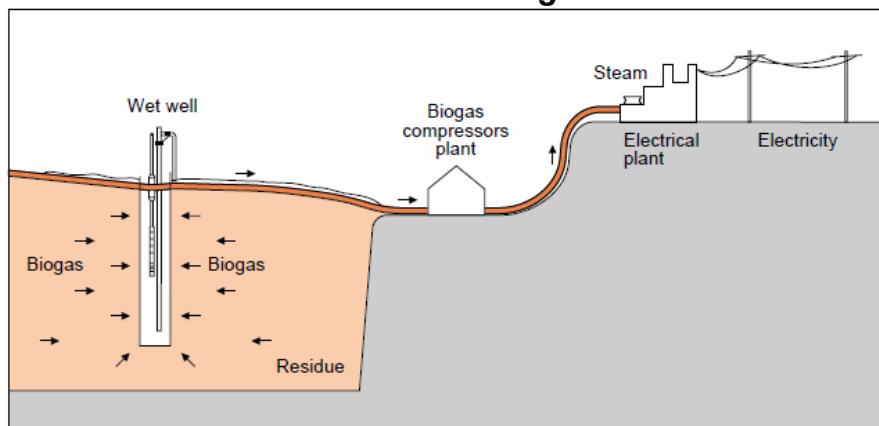
Enerkem/Greenfield are currently constructing a large industrial cellulosic ethanol plant due to open in late 2009 using municipal waste water as the feedstock while Lignol have just opened a large cellulosic ethanol plant using wood residues as the feedstock.

Landfill / Biogas Industry in Canada

Landfill sites generate over a quarter of the methane emissions caused by human activity in Canada, sending 1.2 million tonnes of this potent greenhouse gas into the atmosphere each year. Because the global warming effect of methane is 21 times greater than that of carbon dioxide, this is the equivalent of greenhouse gas emissions from more than six million cars—or 40 per cent of all the passenger vehicles in the country.⁶

Due to decades of excess natural gas production capacity, prices were too low to economically develop landfill/biogas projects. However now that natural gas prices have risen and capture technology has improved, there is great interest in the development of biogas facilities.

Schema of a landfill gas site⁷



Landfill sites are the primary source of biogas production in Canada. Over the past decade, innovative technologies have been developed to capture this gas by drilling deep into landfill sites

⁵ Leader-Post, 2009, <http://www.leaderpost.com/Pulp+mill+could+become+ethanol+plant/1653454/story.html>

⁶ Environment Canada, The Science and the Environment Bulletin, http://www.ec.gc.ca/Science/sandemay99/article1_e.html+landfill+gas+canada&cd=2&hl=en&ct=clnk&gl=ca

⁷ Production of 25 MW from landfill gas, Natural Resources Canada, <http://oee.nrcan.gc.ca/publications/infosource/pub/ci/cadet/english/393.cfm?attr=20>

and pumping it out through a network of pipes. The captured gas is piped to nearby facilities for use as fuel in heating buildings or generating electricity. Burning landfill gas not only converts methane to carbon dioxide, but also destroys most of its harmful components—which can cause nuisance odours, stress on vegetation, smog, and a risk of fire, explosion and asphyxiation. The methane produced by Canadian landfill sites contains enough energy to heat more than 600 000 homes a year.⁸

As of January 2008 there were over 47 landfill gas collection projects in operation in Canada with an increasing emphasis on the cogeneration of electric power and steam. The Landfill gas industry is growing rapidly with many projects under construction and many sites currently being evaluated.

Map of Canadian Landfill Gas Projects⁹



The difference between landfill gas and biogas is that biogas is produced in its own dedicated reactor (in a storage container at farm or at a food processing plant) while landfill gas uses the landfill as the reactor

⁸ Environment Canada, The Science and the Environment Bulletin, http://www.ec.gc.ca/Science/sandemay99/article1_e.html+landfill+gas+canada&cd=2&hl=en&ct=clnk&qj=ca

⁹ Methane to Market Partnership, 2008, www.methanetomarkets.org/resources/landfills/docs/canada_lf_profile.pdf

Industry Clusters

Landfill Gas / Biogas

Near Major Cities

Since most landfill sites are located within driving range of major cities so will most of biogas potential lie. The largest biogas potential lies in the area surrounding the golden horse-shoe (which describes the communities bordering Lake Ontario) as it is one the most dense population center in North America containing a quarter of Canada's population and their garbage. The highly dense population and animal farming corridor between Ottawa, Montreal and Quebec City is another prime location for biogas production from human and animal waste. These two regions already produce over 2/3rd of Canada's landfill gas / biogas output.

There are also a substantial number of digesters producing biogas at Canadian municipal wastewater treatment plants and at industrial plants in the food processing and in the pulp and paper industry (although the actual number is not known). There is also a resurgence of interest in farm scale digesters in Canada primarily in the dairy industry. There are at least 10 in operation across the country today. A few provinces have initiated incentive programs to help this industry grow such as Ontario's Biogas Systems Financial Assistance Program and Quebec's biogaz program.

Cellulosic Ethanol

Saskatchewan

Saskatchewan's large supply of unused cereal straw makes it an ideal candidate for future cellulosic ethanol development. Iogen Corp. will build the first commercial cellulosic ethanol plant in Canada by converting a pulp mill in Prince Albert, Saskatchewan into a cellulosic ethanol plant and bio-energy facility. The project will be a first-of-its-kind facility converting cereal straw to cellulosic ethanol. When construction starts on the project in spring 2010 it will also involve the construction of a \$250-million power plant that produces green energy from forest and ethanol plant residues.

Ottawa

Iogen Corp. has built the world's first demonstration-scale cellulosic ethanol facility in Ottawa, Ontario to convert biomass to cellulose ethanol using enzyme technology. The plant was designed and engineered to process 40 tons per day of wheat straw using enzymes made in an adjacent enzyme manufacturing facility.¹⁰

Edmonton

Enerkem-GreenField Alberta Biofuels (EGAB) a Canadian joint-venture, announced on May 20, 2009 that it has signed a 25-year agreement with the City of Edmonton to build and operate a plant that will produce and sell next generation biofuels, including methanol and cellulosic ethanol, from sorted municipal solid waste. This is the world's first agreement between a large urban centre and a biofuel producer to turn municipal waste into ethanol. The plant will initially produce 36 million litres of biofuels per year.¹¹

Enerkem developed a proprietary gasification process to use a variety of materials as a feedstock to create synthetic gas. The company then uses off-the-shelf catalysts to rearrange the syngas into ethanol, methanol, diesel, or a variety of high-value biochemicals, such as acetic acid or acetate.¹²

As part of the agreement, the City of Edmonton will supply a minimum of 100,000 tonnes of sorted municipal solid waste per year. The sorted municipal solid waste to be used is the ultimate residue after recycling and composting. These residues would otherwise be landfilled.¹³

¹⁰ Iogen Corporation. 09 June 2009 <<http://www.iongen.ca/>>.

¹¹ Edmonton Waste-To-Ethanol. Enerkem. 09 June 2009 <<http://www.enerkem.com/index.php?module=CMS&id=22&newlang=eng>>.

¹² "Enerkem to build N.America's first waste-to-biofuel plant | Cleantech Group." Cleantech Group | Accelerating the next wave of innovation. 09 June 2009 <<http://cleantech.com/news/4482/enerkem-build-namericas-ethanol-waste>>.

¹³ Edmonton Waste-To-Ethanol. Enerkem. 09 June 2009 <<http://www.enerkem.com/index.php?module=CMS&id=22&newlang=eng>>.

British Columbia

Lignol Energy Corporation a BC based cellulosic ethanol researcher is commercializing its unique integrated cellulose to ethanol process technology for biorefining ethanol (fuel alcohol), pure lignin and other valuable co-products from renewable and readily available biomass. Lignol recently established a Cellulosic Ethanol Development Centre in Vancouver which consists of a pilot plant, a state of the art enzyme development laboratory and an engineering group.¹⁴

Ethanol

Ontario

Ontario produces over 61% of Canada's annual corn crop, followed by Quebec at 27%.¹⁵ By 2010 Ontario will produce 1058 MML/d of Ethanol (including plants under construction) exclusively from corn. This production will constitute over 61% of Canada's total ethanol production.

Prairie Provinces

Another emerging starch used for ethanol production is wheat. Outside of Ontario most ethanol production is occurring in the Prairie Provinces using wheat as the primary feedstock. Currently the prairie provinces of Saskatchewan, Alberta and Manitoba produce 538 MML/d constituting over 31% of Canada's ethanol production.

Biodiesel

Near Large Population Centers

Currently biodiesel can be produced by either using waste products such as waste cooking oil and animal fats or by using oilseeds. Companies such as Biox Corp. of Hamilton (located inn the golden horse shoe) have enjoyed great success in using waste products to produce biodiesel.

Prairie Provinces

Since the supply of waste products is limited much of the expansion in new biodiesel production facilities are occurring in the Prairie Provinces where oilseeds can be used to produce biodiesel. The provinces of Saskatchewan, Manitoba and Alberta put together make Canada the largest canola exporter in the world. The readily available supply of local canola can be purchased from farmers at a discount from international market prices while providing farmers with higher realized prices.

Alberta

Alberta expected to release the details of its biodiesel mandate in September, which calls for two percent biodiesel content in the province's diesel supply starting July 31, 2010. Vancouver based Biostreet. has procured land in Vegreville, Alberta for its \$210 million biodiesel plant that will produce 225 million litres per year. The facility will include a canola crushing plant capable of chewing. Biostreet is also in negotiations with Archer Daniels Midland (ADM) to jointly build and operate a 265 million litre plant at the site of ADM's canola crushing facility in Lloydminster. Biostreet is aiming to start building the Lloydminster plant before the end of 2009 and to have the facility operational by Jan. 1, 2011.¹⁶

The Canadian Advantage

Canada is broadly seen as a global leader among industrialized countries for foreign direct investment. A combination of factors, including a favourable business tax environment, other cost factors like electricity, land, and skilled labour, as well as non-cost factors such as the regulatory framework, innovative environment, and overall quality of life, all contribute to Canada's esteemed place on the international landscape.

Business Taxes

Business tax rates are among the many factors that are considered when deciding where to direct investment dollars. The following section illustrates the tax rates across Canadian provincial jurisdictions.

¹⁴ "Lignol Biofuel - Company Overview." *Lignol Biofuel - The Future of Fuel*. Web. 25 Aug. 2009. <<http://www.lignol.ca/about.html>>.

¹⁵ Health Canada, Field Corn, 2006, http://www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/sus-dur/_crop-culture/corn-mais-eng.php?corn+production+canada&cd=6&hl=en&cl=clk&ql=ca

¹⁶ Pratt, Sean. "Biodiesel projects - who's in, who's out." *Western Producer* (2009): 70. Print.

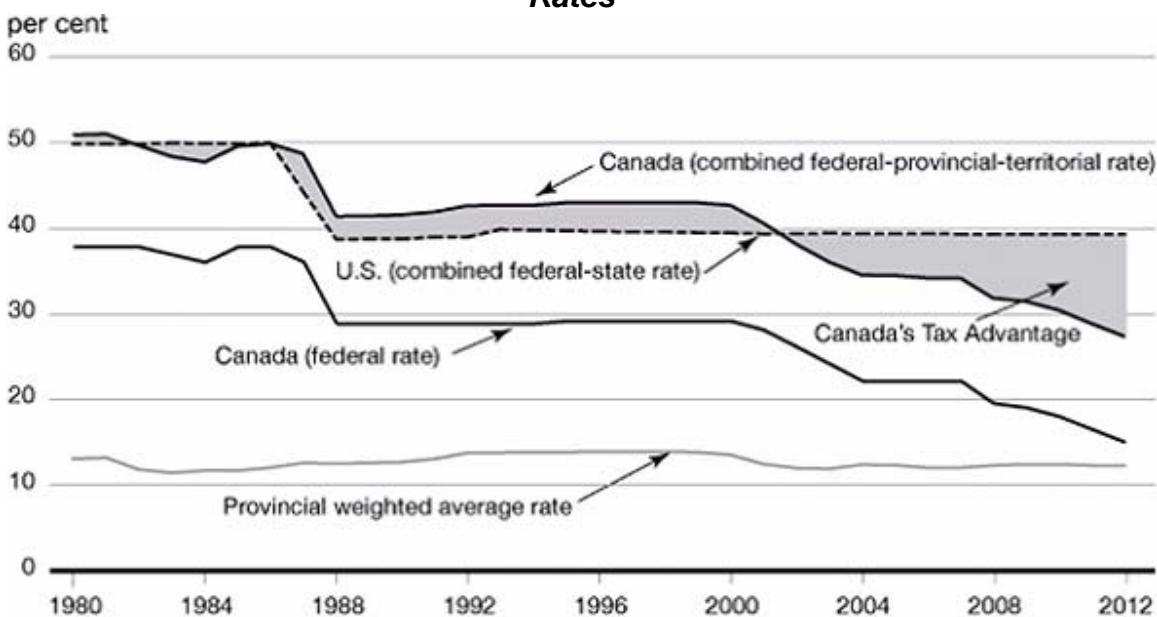
Federal and Provincial/Territorial Tax Rates for Income Earned by a Non-Canadian Controlled Private Corporation (2009)¹⁷

Jurisdiction	Federal	Provincial	Combined
British Columbia	19%	12%	31%
Alberta	19%	10%	29%
Saskatchewan	19%	12%	31%
Manitoba	19%	13%	32%
Ontario	19%	14%	33%
Quebec	19%	11.9%	30.9%
New Brunswick	19%	13%	32%
Nova Scotia	19%	16%	35%
Prince Edward Island	19%	16%	35%
Newfoundland	19%	14%	33%
Northwest Territories	19%	11.5%	30.5%
Nunavut	19%	12%	31%
Yukon	19%	15%	34%

There are also several proposed future tax reductions in multiple Canadian jurisdictions. For example, the 2009 Ontario budget proposes a corporate income tax reduction to 10% from 14% over three years, and the 2009-2010 New Brunswick budget proposes a tax reduction schedule from its current 13% to 8% by July 1, 2012, making it the least taxed jurisdiction in Canada. The federal government has publicly challenged the provinces to lower their business tax rates to 10% by 2012.

The federal government has committed to reducing the general corporate income tax rate to 15% by 2012, which, along with their provincial challenge, would leave the combined corporate income tax rates at 25%. Overall, Canada will have set the lowest overall tax rate on new business investment among the G7 by 2010, and by 2012, the lowest statutory tax rate.

Canadian Tax Advantage, Canada-US Statutory Corporate Income Tax Rates¹⁸



Not only does Canada benefit from a tax advantage compared to its largest trading partner, it is also competitive on the global stage. The table below highlights the tax rates of international OECD jurisdictions (with the exception of Brazil), and includes the world's biofuels leaders (US and Brazil). Canada's combined corporate tax rates are competitive with Spain, Germany and the U.K., and outperform France, Brazil and to a significant extent the United States.

¹⁷ KPMG. December, 2007. http://www.kpmg.ca/en/services/tax/documents/FPT_2008_09.pdf

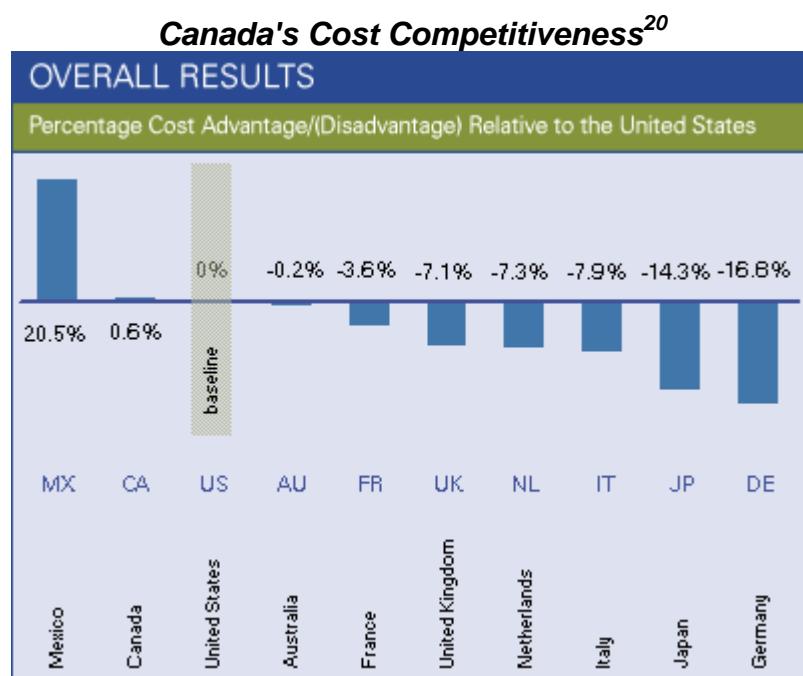
¹⁸ Source: Department of Finance Canada. Budget 2009. <http://www.budget.gc.ca/2009/plan/bpa2-eng.asp>

International Comparison of Combined Corporate Tax Rates, 2008¹⁹

Jurisdiction	Average Rate (per cent)
US	39.25
France	34.43
Brazil	34
Canada (Avg)	32.1
Germany	30.18
Spain	30
UK	28

Canada's Cost Competitiveness

Canada consistently ranks near the top of its class in comparative international studies on business conditions. An international survey of business conditions conducted by KPMG in 2008 illustrates the cost of doing business in nine leading international jurisdictions plus Mexico. The study shows that, overall, Canada ranks ahead of all other international jurisdictions except for Mexico, which is separately classed as an emerging industrialized country.



Special attention should be paid to France, Germany and the United States, since these are the jurisdictions in the OECD with the most installed biofuels production capabilities. Their low relative ranking for the following cost factors suggests that if biofuels can be successful in these jurisdictions even with such a cost disadvantage, locating in Canada would be a favourable course to follow.

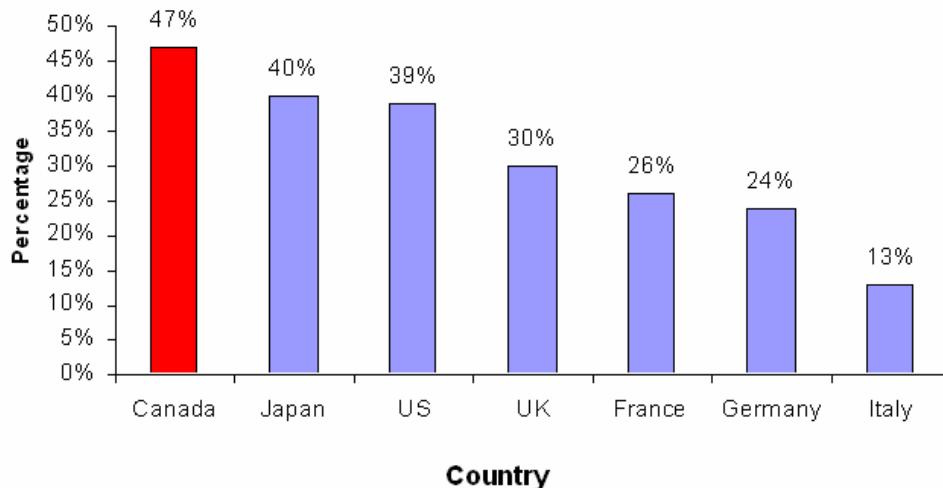
Qualified Labour Force Availability

Canada is home to the most educated population in the world with the highest rate of graduates from tertiary education programs in the OECD. Canada spends the most money in the world on education, as a percentage of GDP, and has the highest tertiary educational attainment rates among OECD countries

¹⁹ Source: OECD. (2008). Taxation of corporate and capital income. <http://www.oecd.org/dataoecd/26/56/33717459.xls>

²⁰ Source: KPMG. (2008). *Competitive Alternatives: KPMG's Guide to International Business Location, 2008 Edition*. http://www.mmkconsulting.com/compalts/reports/2008_compalts_execsum_en.pdf

Tertiary Educational Attainment Rates, G7 Comparison, 2006²¹



The capability, knowledge and availability of human resources are of significant importance for firms looking to expand their business into other countries. Canada has a healthy and growing labour landscape in the solar photovoltaic industry.

Stable Banking System

Canada enjoys the most stable banking environment in the world. An October, 2008 report from the World Economic Forum ranked Canada as having the world's most stable banking environment, partly due to a strong system of regulation, transparency, and oversight, and Canada's cautious banking culture.

Cheap & Abundant Clean Electricity

Canada boasts low electricity costs, a very stable supply, and a high proportion of clean, renewable energy in its national energy mix. Electricity costs compared to other international jurisdictions can be seen in below. This is particularly important as electricity costs are the second largest variable cost in ethanol production after the feedstock whether it is corn or wheat.²²

2005 Cost Structure of 99.5% Corn Ethanol Per 1000 Litres²³

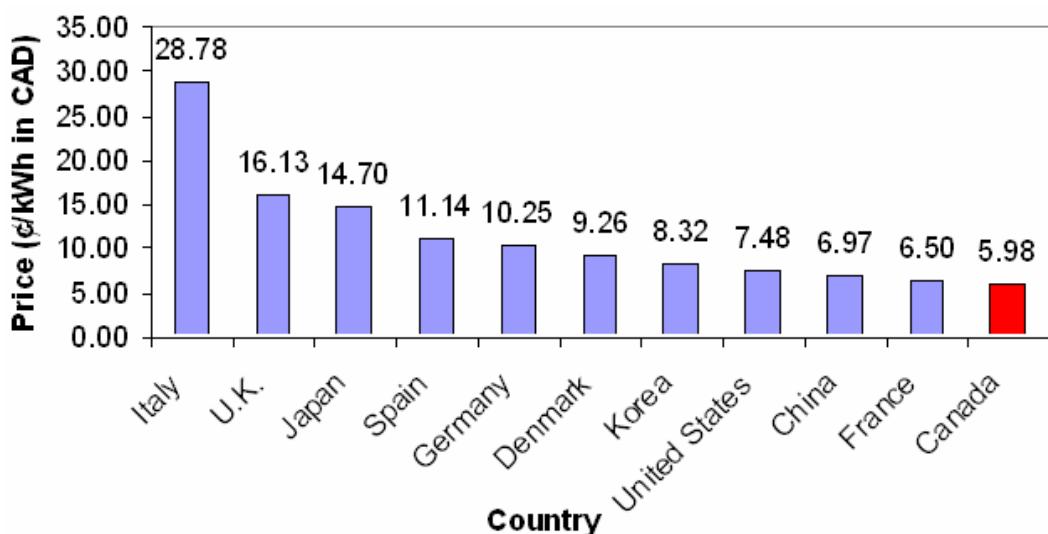
Inputs	Quantity	kcal × 1000	Dollars \$
Corn grain	2,690 kg ^b	2,522 ^b	284.25 ^b
Corn transport	2,690 kg ^b	322 ^c	21.40 ^d
Water	40,000 L ^e	90 ^f	21.16 ^g
Stainless steel	3 kg ⁱ	12 ⁱ	10.60 ^d
Steel	4 kg ⁱ	12 ⁱ	10.60 ^d
Cement	8 kg ⁱ	8 ⁱ	10.60 ^d
Steam	2,546,000 kcal ^j	2,546 ^j	21.16 ^k
Electricity	392 kWh ^j	1,011 ^j	27.44 ^l
95% ethanol to 99.5%	9 kcal/L ^m	9 ^m	40.00
Sewage effluent	20 kg BOD ⁿ	69 ^h	6.0
Total		6,597	\$453.21

²¹ Source: OECD. (2008). Education at a Glance 2008: OECD Indicators. <http://browse.oecdbookshop.org/oecd/pdfs/browseit/9608041E.PDF>

²² Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower, 2005, <http://petroleum.berkeley.edu/papers/Biofuels/NRRehtanol.2005.pdf>

²³ Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower, 2005, <http://petroleum.berkeley.edu/papers/Biofuels/NRRehtanol.2005.pdf>

International Electricity Price Comparison, ¢/kWh²⁴



When the values are disaggregated, some strikingly inexpensive Canadian jurisdictions emerge that offer particularly competitive rates.

²⁴ Source: Adapted from the Ontario Power Authority. (2008). *Delivered Electricity Price Comparison*. http://www.powerauthority.on.ca/Storage/80/7555_Delivered_Electricity_Price_Comparison3.pdf

Electricity Rate Comparison, April 1, 2008²⁵

Summary Table (including taxes)

Residential		General					
		Small Power	Medium Power			Large Power	
Power demand	40 kW	500 kW	1,000 kW	2,500 kW ²		5,000 kW ²	50,000 kW ³
Consumption	1,000 kWh	10,000 kWh	100,000 kWh	400,000 kWh	1,170,000 kWh	3,060,000 kWh	30,600,000 kWh
Load factor	35%	28%	56%	65%		85%	85%
Canadian Cities							
Montréal, QC	7.69	9.98	12.42	8.02	6.61	5.34	5.05
Charlottetown, PE	15.55	16.21	17.26	13.99	13.51	9.18	9.18
Edmonton, AB ⁴	14.12	13.98	13.92	12.76	12.53	10.86	10.18
Halifax, NS	12.34	13.07	14.59	10.80	9.37	7.95	7.95
Moncton, NB	13.01	13.27	14.27	11.69	11.32	7.67	7.31
Ottawa, ON	11.14	10.79	11.95	9.98	9.80	9.54	9.09
Regina, SK	12.55	10.55	13.40	9.79	8.14	7.28	6.16
St. John's, NL ⁵	11.79	12.13	11.67	8.87	8.35	7.88	4.50
Toronto, ON	11.72	11.22	12.96	10.08	9.63	9.16	8.88
Vancouver, BC	7.55	8.58	7.99	6.02	5.59	5.20	4.31
Winnipeg, MB	7.38	7.41	8.44	5.70	4.75	4.21	3.55
American Cities							
Boston, MA	19.12	20.76	22.72	17.64	16.80	15.18	15.17
Chicago, IL ⁶	12.72	11.43	14.25	12.79	12.48	12.14	9.77
Detroit, MI ⁶	12.90	12.25	12.16	9.55	8.39	7.61	7.38
Houston, TX ⁶	15.04	10.40	11.44	9.41	9.19	8.69	8.06
Miami, FL ⁶	11.68	12.82	13.72	11.08	10.51	10.00	9.00
Nashville, TN	9.45	10.53	12.82	9.15	8.87	7.70	6.56
New York, NY ⁶	22.93	24.06	26.62	20.10	18.10	16.83	16.83
Portland, OR	8.89	7.34	7.39	5.56	4.96	4.71	4.38
San Francisco, CA ⁶	19.44	16.39	17.58	13.17	9.59	9.01	8.98
Seattle, WA	6.77	5.66	5.32	4.88	4.87	4.85	4.58
AVERAGE	12.56	12.33	13.47	10.53	9.68	8.62	7.95

- 1) In Canadian Dollars
- 2) Supply voltage of 25kV
- 3) Supply voltage of 120 kV
- 4) Bills corresponding to consumption levels of 250,000 kWh/year or more have been estimated by Hydro-Quebec based on the applicable general rate
- 5) Newfoundland and Labrador Hydro rates for customers with a power demand of 30,000 kW or more; Newfoundland Power rates for all other customer categories.
- 6) These bills have been estimated by Hydro-Quebec and may differ from actual bills.

Beyond its low electricity prices and the stability of supply, clean energy dominates Canada's overall energy mix. Canada produces nearly two-thirds of its energy from clean sources like hydro, with hydro power comprising more than 90% of the electricity mix for Quebec, Manitoba, Newfoundland and British Columbia. This is a particularly salient feature for producers of ethanol and biodiesel since the value proposition for consumers of their products includes the

²⁵ Source: Hydro Quebec. (2008). *Electricity Rate Comparison*. http://www.hydroquebec.com/publications/en/comparison_prices/pdf/comp_2008_en.pdf

environmental aspects of production. Using clean energy to produce clean liquid fuels brings make biofuels even more sustainable than in the US where coal constitutes the largest source of electricity.

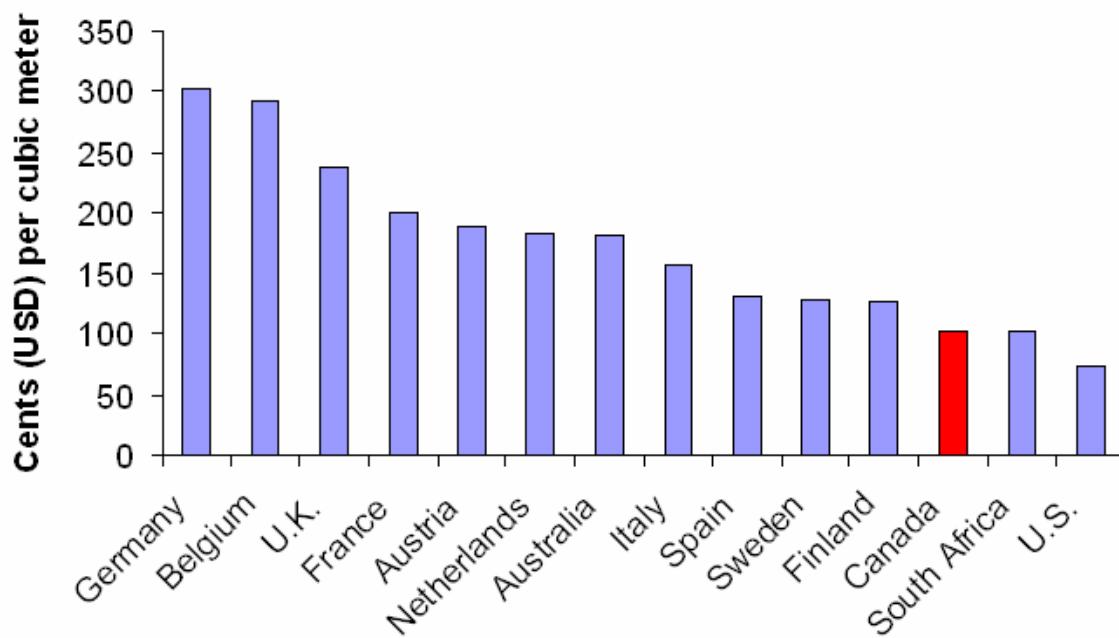
Additionally, establishing manufacturing facilities in clean-energy jurisdictions mitigates future risks posed by increasingly carbon-constrained economies. It is likely that carbon pricing, carbon taxes, or cap-and-trade systems will become more widespread in the near future, and industries located in areas with a clean electricity mix will avoid the costs that carbon-intense electricity consumers will have to bear.

Cheap & Abundant Water

Ethanol production requires access to abundant, inexpensive, clean water. Estimates of water usage during ethanol production range from 3 to 4 gallons of water per gallon of ethanol produced.²⁶ Even when taking into account the high level of water recycling, ethanol uses considerable water resources.

The cost of water varies widely in the developed world. In Canada, water price are set by provinces and municipalities. Most provinces levy licence fees to major water users for access to the resource. The provincial licence fees for water are not set in accordance with any pricing principles, but rather are related to the cost of administering the licensing program.

International Water Cost Comparison, 2008²⁷



Municipalities also levy charges to water users. In many areas, users are charged a flat monthly, quarterly, or annual rate in exchange for access to unlimited amounts of treated water. In other places, the charges are based on the volume of water used, as measured by a water meter.

Transportation Linkages

Because ethanol picks up excess water and impurities it can't travel in pipelines along with gasoline. However Canada's extensive truck, rail and port services can provide efficient access to consumers and the suppliers to the ethanol and biodiesel industry.

Roads

Canada is ranked 1st for road provision among all G7 countries. In 2004, the Canadian road network of 1.4 million km of roadways. The Trans-Canada Highway is the longest highway in the

²⁶ Water Usage for Current and Future Ethanol Production, Andy Aden, National Renewable Energy Laboratory, 2007
http://www.swhydro.arizona.edu/archive/V6_N5/feature4.pdf

²⁷ Source: Adapted from NUS Consulting Group. (2008). 2007-2008 International Water Report and Cost Survey.
<http://www.nusconsulting.com/downloads/2008WaterAbridged.pdf>

world at 7,821 km, linking all 10 provinces. Freight tonnage carried every year on Canadian highways is estimated to be close to 400M tonnes.

Railways

Canada's railways system is the third largest among OECD countries at 73,000 km, with significant links to the US. There is also easy access to Canada's major ports and to interior communities through truck-rail intermodal service. In 2004, Canadian railways moved 260.8M tonnes of freight.

Ports

Canada has the world's longest inland waterway open to ocean shipping—the Great Lakes/St. Lawrence Seaway System. The Seaway provides a direct route to the industrial heart of North America and handles some 200M tones of cargo each year. Major ports include Vancouver, Montréal, Halifax, Port Cartier, Sept Iles/Pointe Noire, Saint John and Québec City. Modern container facilities at major ports connect with inland container trains to ensure rapid movement of goods throughout North America.

Federal Biofuels Incentives & Programs

ecoENERGY for Biofuels – This program from Natural Resources Canada supports the production of renewable alternatives to gasoline and diesel and encourages the development of a competitive domestic industry for renewable fuels. The program provides an operating incentive to facilities that produce renewable alternatives to gasoline and diesel in Canada. ecoENERGY for Biofuels will invest up to \$1.5 billion over nine years in support of biofuel production in Canada. The program runs from April 1, 2008 to March 31, 2017. Recipients will be entitled to receive incentives for up to seven consecutive years.

<http://oee.nrcan.gc.ca/transportation/ecoenergy-biofuels/index.cfm?attr=0>

Fiscal Year *	Maximum incentive rate payable (\$ 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	

* April 1 of a given year to March 31 of the following year.

Clean Energy Generation: Accelerated CCA – Under the capital cost allowance (CCA) regime in the income tax system, Class 43.2 of Schedule II to the Income Tax Regulations provides accelerated CCA (50 per cent per year on a declining balance basis) for specified clean energy generation equipment acquired before 2020. The class incorporates by reference a detailed list of eligible equipment that generates energy in the form of electricity or heat, by: using a renewable energy source (e.g. wind, solar, small hydro, biofuels); using waste fuel (e.g. landfill gas, wood waste, manure); or making efficient use of fossil fuels.

<http://www.ic.gc.ca/eic/site/fte-fte.nsf/eng/00004.html>

Scientific Research and Experimental Development (SR&ED) Tax Credit Program – Is a federal tax incentive program to encourage Canadian businesses of all sizes and in all sectors to conduct research and development (R&D) in Canada that will lead to new, improved, or technologically advanced products or processes. The SR&ED program is the largest single source of federal government support for industrial research and development. Claimants can apply for SR&ED investment tax credits for expenditures such as wages, materials, machinery, equipment, some overhead, and SR&ED contracts.

<http://www.cra-arc.gc.ca/txcrdt/sred-rsde/menu-eng.html>

ecoAgriculture Biofuels Capital Initiative (ecoABC) – Is a federal \$200 million four-year program ending on March 31, 2011 that provides repayable contributions for the construction or expansion of transportation biofuel production facilities. Funding is conditional upon agricultural producer investment in the biofuel projects, and the use of agricultural feedstock to produce the biofuel.

<http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1195672401464&lang=eng>

Agri-Opportunities Program – Is a \$134 million program, announced in January 2007, is a 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 are ready to be introduced to the marketplace. Agri-Opportunities is delivered nationally by Agriculture and Agri-Food Canada.

Funding is provided to projects that focus on new agri-food, agriculture or bioproducts, that can be expected to increase market opportunities for the Canadian agricultural industry across the value chain and generate demand for primary agricultural products.

The Agri-Opportunities Program provides a maximum repayable contribution of \$10 million per project and per recipient regardless of the number of projects, over the life of the program, ending in March 2011.

<http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1195488674667&lang=eng>

Green Infrastructure Fund – Is a \$1-billion fund intended to focus on green priorities such as building transmission lines for clean hydro, upgrading wastewater treatment systems, and investing in wind and solar power. The Fund deals with large, strategic infrastructure and is available to private companies and will be allocated over 5 years based on merit to support green infrastructure projects on a cost-shared basis.

<http://www.buildingcanada-chantierscanada.gc.ca/media/news-nouvelles/2009/gif-fiv-eng.html>

Green Municipal Funds (GMF) – The GMF was established by the Government of Canada to stimulate municipal investment in innovative environmental infrastructure projects and practices to: improve air, water and soil quality; protect the climate; remediate brownfields; and promote the use of renewable resources. The GMF is managed at arm's-length by the Federation of Canadian Municipalities (FCM), which uses grants, loans or loan guarantees to support feasibility studies, sustainable community plans, field tests and capital implementation projects. These GMF investments in Canadian municipalities, which aim to generate significant environmental as well as economic and social benefits, may be leveraged further by partnerships with public or private entities. Canadian municipalities or a public non-governmental organization or private sector organization applying in partnership with a municipality are eligible to apply.

On February 13, 2008 FCM issued a GMF Request for Proposals (RFP) for financing to support implementation of leading edge municipal solid waste diversion projects. GMF will award a total of up to \$10 million in loans and up to \$1.5 million in grants under this RFP. Eligible applicants can request up to \$3 million in loans and \$300,000 in grants for each project.

www.fcm.ca

NextGen Biofuels Fund – Is a program made available through Sustainable Development Technology Canada with the goal to increase each project's chances of success to market by helping them bridge the high CAPEX gap while, at the same time, helping them to scale-up their technology solution to a large, demonstration-scale plant.

The NextGen Biofuels Fund™ will support up to 40% of eligible project costs for the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation renewable fuels. The contribution is repayable based on free cash flow over a period of 10 years after project completion. The funding process for the NextGen Biofuels Fund™ uses a classic Project Assurance Process approach based on international best practices in deciding whether to undertake the development of large-scale, capital intensive, or high capital expenditure, projects.

http://www.sdtc.ca/en/funding/NextGen_Biofuels_Fund/index.htm

Figure 1 Provincial Ethanol Incentives & Programs - May 2009²⁸

[All Atlantic Provinces and the Territories do not currently provide incentives for Ethanol]

*Other conditions may apply

Prov	Name	Type	Description	* Main Condition	Fund & Duration
BC	Alternative Fuels Program	Use	<ul style="list-style-type: none"> ○ Motor fuel tax exemption: 14.5 cents / L 	Sold in BC	N/A ('04 -)
AB	Biorefining Commercialization Market Development Program	Capital	<ul style="list-style-type: none"> ○ Grant to support feasibility, market/technology development and bioenergy plant construction 	Produced in AB	Part of \$239 M Bioenergy Plan ('07 - '11)
AB	Bioenergy Infrastructure Development Program	Capital	<ul style="list-style-type: none"> ○ Grant to support product marketing infrastructure capital construction 	Produced in AB	Part of \$239 M Bioenergy Plan ('07 - '11)
AB	Bio-fuel and Bio-gas Producer Credit Program	Producer	<ul style="list-style-type: none"> ○ Non-repayable & fixed, based on production volume ○ Producer credit rate: <ul style="list-style-type: none"> ○ 9 cents / L (production ≥150 M L / year) ○ 14 cents / L (production <150 M L / year) 	Produced in AB	Part of \$239 M Bioenergy Plan ('07 - '11)
SK	SaskBio	Capital	<ul style="list-style-type: none"> ○ Repayable & variable, based on production volume and farmer-community equity investment ○ \$0.05/litre to lesser of \$0.10/litre or \$10M per project 	5% to 50% farmer equity investment	\$80 M ('07 - '11)
	Ethanol Program	Use	<ul style="list-style-type: none"> ○ Distributor payment (grant) program of up to 15 cents / L 	Produced and used in SK	N/A ('05 -)
MB	Ethanol Fund	Producer	<ul style="list-style-type: none"> ○ Fixed incentive grant, variable over 8 year program: <ul style="list-style-type: none"> ○ 20 cents / L (2008 & 2009) ○ 15 cents / L (2010, 2011, 2012) ○ 10 cents / L (2013, 2014, 2015) ○ Capped at mandated requirement (~130 M L / year) 	Produced and sold in MB	A portion of gas tax revenue ('08 - '15)
ON	Ontario Ethanol Growth Fund (OEGF)	Capital	<ul style="list-style-type: none"> ○ Non-repayable & variable, based on production ○ Does not exceed 10 cents / L of plant capacity 	Produced in ON	\$520 M ('05 - '17)
		Producer	<ul style="list-style-type: none"> ○ Non-repayable & variable, based on market conditions ○ Does not exceed 11 cents / L of annual production 		
QC	-	Producer	<ul style="list-style-type: none"> ○ Income tax credit of up to 18.5 cents / L ○ Maximum production of 126 ML/yr or 1,200 ML over 10 years ○ Non-repayable & variable, based on price of crude 	Produced and sold in QC	('06 - '18)

²⁸ Fuels Policy & Programs Division, Natural Resources Canada, February 4th 2008

Figure 2: May 2009 - Provincial Biodiesel Incentives - May 2009²⁹

[NB, NL, PE and the Territories do not currently provide incentives for Biodiesel]

*Other conditions may apply

Prov	Name	Type	Description	* Main Condition	Fund & Duration
BC	Alternative Fuels Program	Use	<ul style="list-style-type: none"> ○ Motor fuel tax exemption: 15 cents / L 	Sold in BC	N/A ('07 -)
AB	Biorefining Commercialization Market Development Program	Capital	<ul style="list-style-type: none"> ○ Grant to support feasibility, market/technology development and bioenergy plant construction 	Produced in AB	Part of \$239 M Bioenergy Plan ('07 - '11)
AB	Bioenergy Infrastructure Development Program	Capital	<ul style="list-style-type: none"> ○ Grant to support product marketing infrastructure capital construction 	Produced in AB	Part of \$239 M Bioenergy Plan ('07 - '11)
AB	Bio-fuel and Bio-gas Producer Credit Program	Producer	<ul style="list-style-type: none"> ○ Non-repayable & fixed, based on production volume ○ Producer credit rate: <ul style="list-style-type: none"> ○ 9 cents / L (production \geq150 M L / year) ○ 4 cents / L (production <150 M L / year) 	Produced in AB	Part of \$239 M Bioenergy Plan ('07 - '11)
SK	SaskBio	Capital	<ul style="list-style-type: none"> ○ Repayable & variable, based on production volume and farmer-community equity investment ○ Capital incentives of up to \$10 M / project 	5% to 50% farmer equity investment	\$80 M ('07 - '11)
MB	-	Use	<ul style="list-style-type: none"> ○ Applicable to the biodiesel portion of blends with diesel fuel: ○ Road tax exemption: 11.5 cents / L ○ Sales tax exemption: 7% 	Produced and sold in MB	N/A ('06 - '11)
ON	-	Use	<ul style="list-style-type: none"> ○ 14.3 cents / L road tax exemption 	Sold in ON	N/A ('05 -)
QC	-	Use	<ul style="list-style-type: none"> ○ Fuel tax refund of 16.2 cents / L on the purchase of pure (B100) biodiesel 	Sold in QC	N/A ('06 -)
NS	-	Use	<ul style="list-style-type: none"> ○ Up to 15.4 cents / L tax exemption 	Produced in NS	N/A ('06 -)

²⁹ Fuels Policy & Programs Division, [Natural Resources Canada](#), February 4th 2008

Figure3: Corporate Income Tax Rates, Provincial, Territorial, and Combined

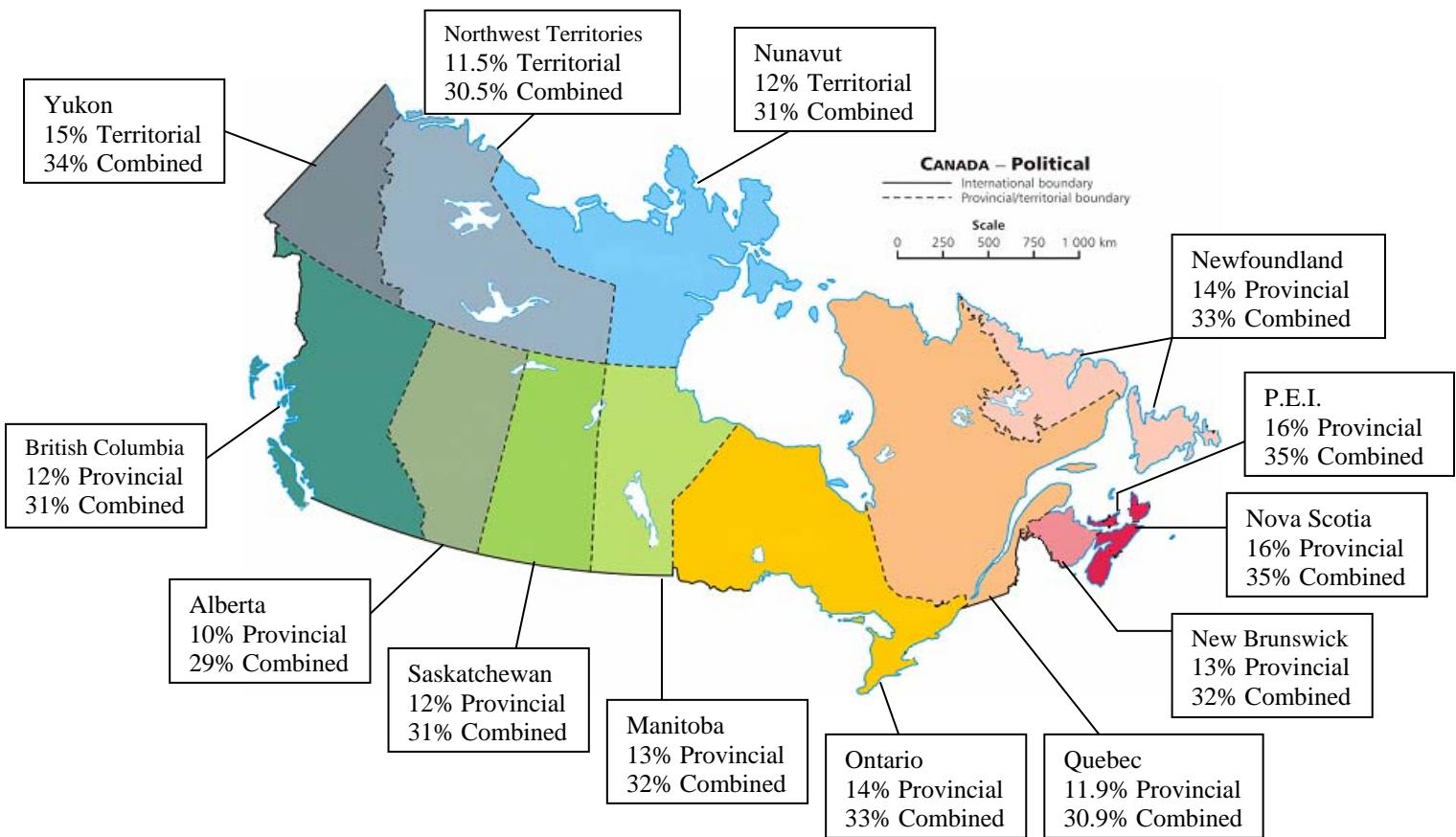
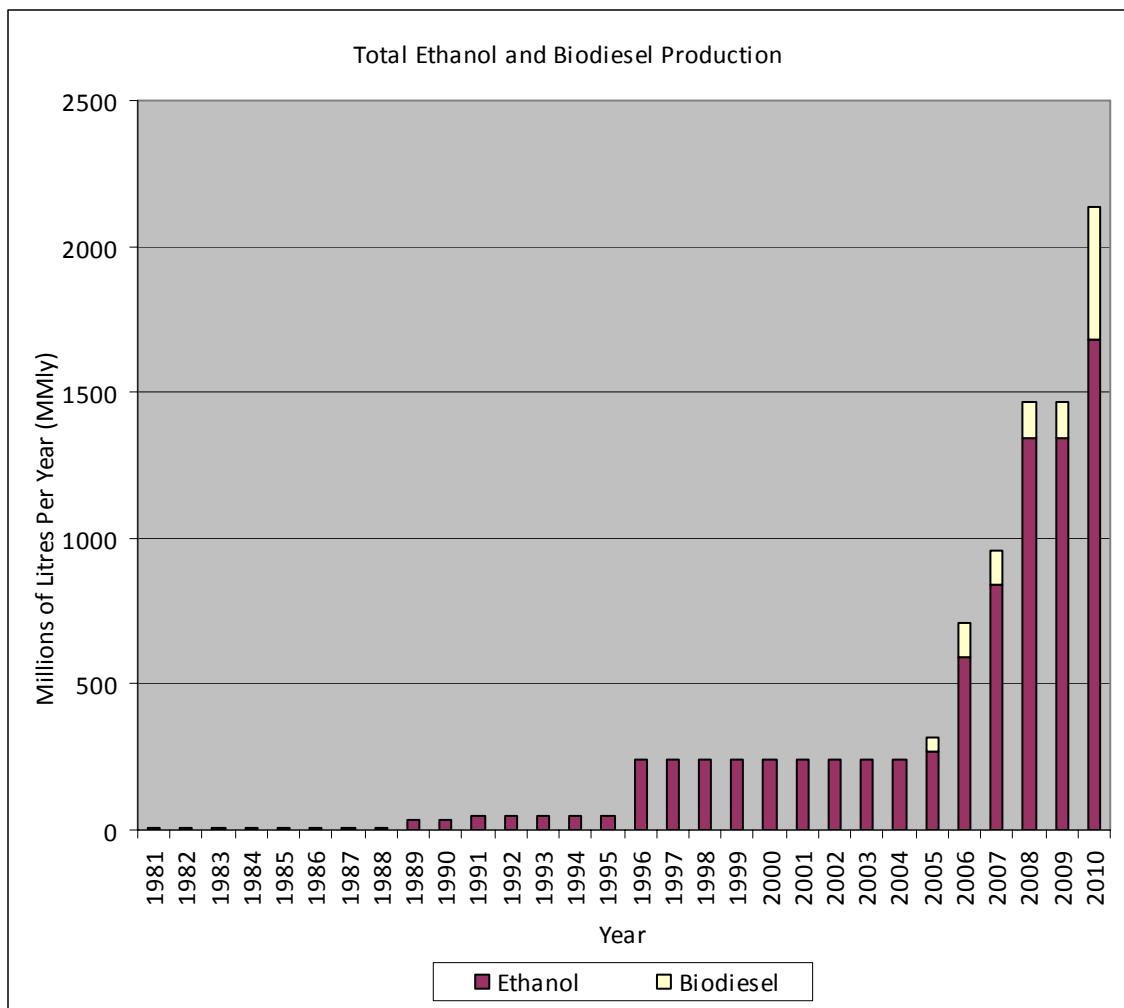


Figure 4: Map of Most Canadian Biofuels (Ethanol and Biodiesel) Production Plants³⁰



³⁰ Canadian Renewable Fuels Association. 03 June 2009 <<http://www.greenuel.org/maps.php>>

Figure 5: Total Ethanol and Biodiesel Production in Canada³¹



Note: The 2010 figure includes all projects currently under construction and due to be completed.

³¹ Compiled with data provided by:
Canadian Renewable Fuels Association. 03 June 2009 <<http://www.greenuel.org/lists.php>>

Figure 6: Canadian Ethanol Production List – January 2009³²

Plant Name (ID #, Figure 4)	City	Province	Feedstock	Capacity*
(1) Collingwood Ethanol LP	Collingwood	ON	Corn	50
(2) Enerkem Inc.	Westbury	PQ	Wood Waste	5
(3) GreenField Ethanol	Johnstown	ON	Corn	200
(4) GreenField Ethanol	Varennes	PQ	Corn	120
(5) GreenField Ethanol	Tiverton	ON	Corn	26
(6) GreenField Ethanol	Chatham	ON	Corn	150
(7) GreenField Ethanol**	Hensall	ON	Corn	200
(8) GreenField Ethanol - Enerkem Inc.**	Edmonton	AB	Municipal Landfill Waste	36
(9) Husky Energy	Lloydminster	SK	Wheat	130
(10) Husky Energy***	Minnedosa	MB	Corn	130
(11) IGCP Ethanol Inc.	Aylmer	ON	Corn	150
(12) Iogen Corporation	Ottawa	ON	Straw from wheat, barley, and oats	2
(13) Kawartha Ethanol**	Havelock	ON	Corn	80
(14) NorAmera BioEnergy Corp.	Weyburn	SK	Wheat	25
(15) North West Bio-Energy**	Unity	SK	Wheat	25
(16) Permolex International, L.P.	Red Deer	AB	Wheat	40
(17) Pound-Maker Agventures Ltd.	Lanigan	SK	Wheat	12
(18) Suncor St. Clair Ethanol Plant****	Sarnia	ON	Corn	200
(19) Terra Grain Fuels Inc.	Belle Plaine	SK	Wheat	150

* capacity noted in millions of litres per year (MMly).

** plan currently under construction

*** 10 MMly plant originally started in 1981

**** producing at 200 MMly, planning to double capacity

³² Canadian Renewable Fuels Association, 03 June 2009 <<http://www.greenuel.org/lists.php>>

Figure 7: Canadian Biodiesel Production List – January 2009³³

Plant Name (ID #, Figure 4)	City	Province	Feedstock	Capacity*
(20) Bifrost Bio-Blends Ltd.	Arborg	MB	Canola Oil	3
(21) Bio-Diesel Quebec Inc.	St-Alexis-des-Monts	PQ	Yellow Grease	10
(22) Biox Corp.	Hamilton	ON	Multi-Feedstock	66
(23) Canadian Bioenergy **	Sturgeon County	AB	Canola	225
(24) Eastman Bio-Fuels Ltd.**	Beausejour	MB	Canola	11
(25) Greenway Biodiesel**	Winnipeg	MB	Canola	20
(26) Kyoto Fuels**	Lethbridge	AB	Multi-Feedstock	66
(27) Methes Energies Canada Inc.**	Mississauga	ON	Multi-Feedstock	5
(28) Milligan Bio-Tech Inc.	Foam Lake	SK	Canola	1
(29) Rothsay Biodiesel	Montreal	PQ	Tallow/Yellow Grease	30
(30) Western Biodiesel Inc.	Calgary	AB	Multi-Feedstock	19

* capacity noted in millions of litres per year (MMly).

** plan currently under construction

*** 10 MMly plant originally started in 1981

**** producing at 200 MMly, planning to double capacity

³³ Canadian Renewable Fuels Association, 03 June 2009 <<http://www.greenuel.org/lists.php>>

Additional Resources

The following are resources that can be used to find out more about biofuels in Canada:

Government

Biodiesel Guide – This guide provided by Natural Resources Canada provides an overview of Biodiesel and its use in the transportation sector.

<http://oee.nrcan.gc.ca/transportation/fuels/biodiesel/biodiesel.cfm?attr=8>

Ethanol Guide – This guide provided by Natural Resources Canada provides an overview of Ethanol and its use in the transportation sector.

<http://oee.nrcan.gc.ca/transportation/fuels/ethanol/ethanol.cfm?attr=8>

Clean Air Act – The act enables the Federal Government to establish clear national standards, to move industry from voluntary compliance to regulations, to monitor progress, and to report to Canadians on the gains that Canada is making in reducing pollution and greenhouse gas emissions. The Clean Air Act amends CEPA to enable the government to regulate the blending of fuels and their components.

http://www.ec.gc.ca/cleanair-airpur/Clean_Air_Act-WS1CA709C8-1_En.htm

Bioenergy – Provides general information on biofuels and the role they can play in Canada's energy mix.

<http://biobasics.gc.ca/english/view.asp?x=796>

Industry

Canadian Renewable Fuels Association – Founded in 1984, (CRFA) is a non-profit organization with a mission to promote the use of renewable fuels for transportation through consumer awareness and government liaison activities. The CRFA membership is composed of representatives from all levels of the ethanol and biodiesel industry, including: grain and cellulose ethanol producers, biodiesel producers, fuel technology providers, and agricultural associations.

<http://www.greenuel.org/index.php>

Association Québécoise du Biogaz – Is a Québec based industry association which promotes the production of biogas in the province of Québec.

<http://www.biogazquebec.ca/>

CANBIO – Is a national, industry-driven, non-profit organization of individuals, businesses and non-governmental organizations interested in the development, promotion and use of bioenergy.

<http://www.canbio.ca/>

Canola Biodiesel – Is a website managed and delivered by the Canola Council of Canada with the goal of educating the public on canola's role in the biodiesel industry. The Council is a non-profit association representing the entire Canadian canola industry — growers, input suppliers, researchers, crushers, processors, exporters and marketers.

<http://www.canola-council.org/>

Ethanol Facts – Is a website developed by the Ethanol Promotion and Information Council promoting the use of ethanol as a renewable fuel.

<http://www.ethanolfacts.com/>

Alberta Renewable Diesel Demonstration (ARDD) – Is Canada's largest cold-weather study of renewable diesel fuels, has successfully demonstrated the on-road use of low level renewable diesel blends in a range of Canadian climatic conditions.

<http://www.renewablediesel.ca/>

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