MARKET OPPORTUNITIES ANALYSIS FOR CANADIAN SOYBEANS

Section 2

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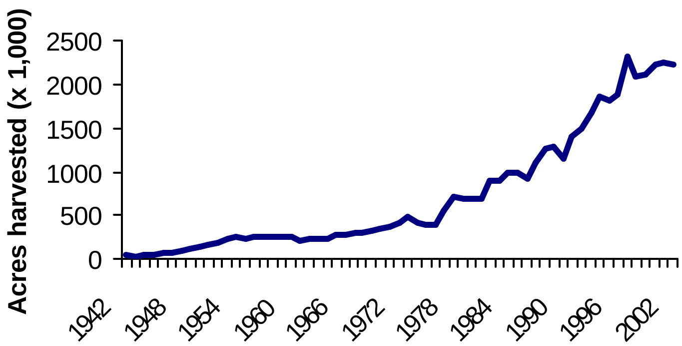
Existing Market

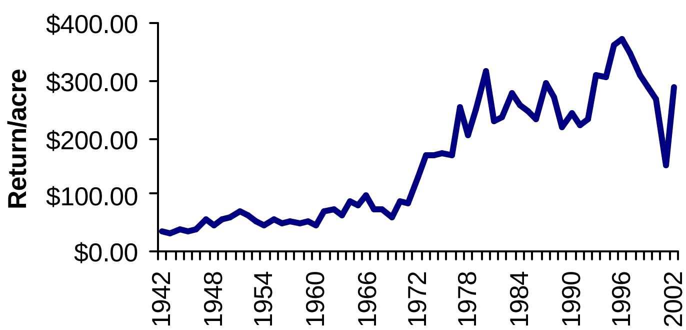
Soybean acreage has grown steadily over the last sixty years. The growth appears to accelerate but actually from 1942 to 1976 acreage increased an average of 7.7% per year, while from 1977 to 2002 acreage increased an average of 7.8% per year.

Chart 1: Acreage planted to soybean from 1942 to 2002



Yield has increased an average of 2.6% per year over the same time period. Combined with the price per bushel this has resulted in a steady strong increase in value per acre over the same time period.

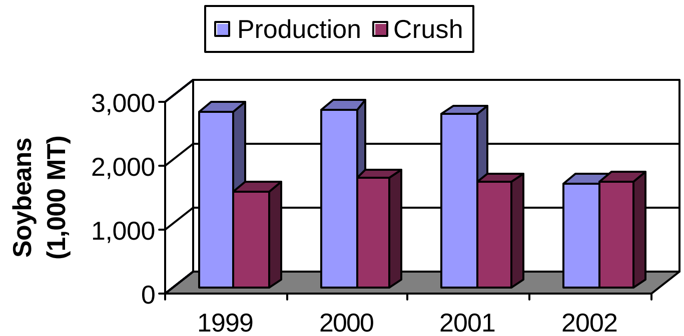
Chart 2: Gross return per acre from soybean from 1942 to 2002



We have not normalized values for any specific point in time. It is clear that this increase in soybean acreage has been driven by increases in return per acre. It is also clear that variation in return per acre has increased in recent years. This increase in variability has the potential to cause more value loss to Canadian farmers now, because of the growth in acreage. The dip shown in 2001 represents a decrease in return/acre, this is even more significant when you multiply it by the increase in acreage.

The amount of soybean crushed in Canada (predominantly at the ADM and Canamera crushing facilities in Ontario) has remained relatively steady in recent years.

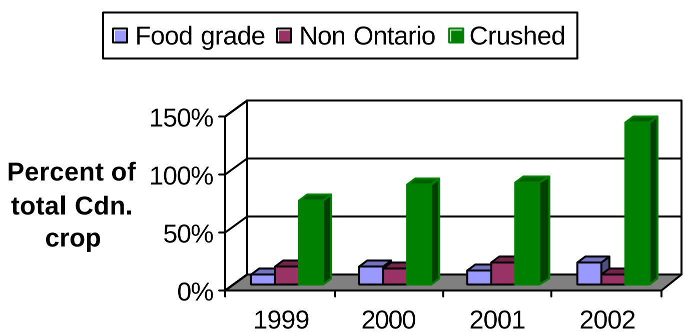
Chart 3: Amount of soybean produced and crushed in Canada in recent years



The year indicated represents the crop year starting the previous September and ending in August of the year indicated. The decrease in production in the 2002 crushing year (based on 2001 crop production) required importation of soybean from the U.S. to satisfy crushing capacity.

If we consider the food grade soybean exported to the U.S. and the soybeans produced outside of Ontario as not being available for crushing we see that domestic crushing demand is reasonably close to domestic supply.

Chart 4: Percentage of commodity crop crushed from Ontario



The difference between 100% domestic crush and supply in years other than 2002 also includes grain used for seed production, and other domestic uses of whole soybean grain.

Soy 20/20 Estimation of Future Market Growth Potential

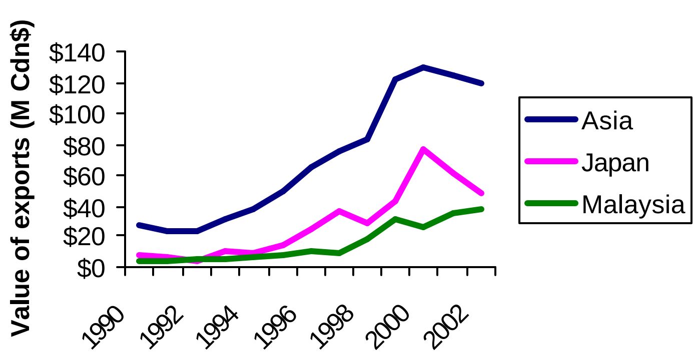
Continuing increases in soybean production in South America and a maintenance of current levels in the U.S. has been projected to have a negative effect on demand for soybean oil. However, soybean prices both for grain and oil have remained strong over the last four years. A reasonable assumption is that world demand has increased at a similar rate to increases in supply. World demand will continue to increase, whereas production is not projected to increase at the same rate in the future in South America as it has in recent years. Soybean acreage in Argentina is nearing capacity, thus future increases will likely be driven primarily by the development of incremental arable land in west central Brazil. Crop production and choices in this area will be driven by world market prices, thus soybean production increases should slow in response to declines in prices. Soybean production on these incremental acres will also slow as soil productivity declines. This will be alleviated through increased crop rotation and higher fertilizer inputs, however higher input costs will reduce the attractiveness of soybean production in this area.

Thus, Soy 20/20 projects crushing demand for domestically grown soybeans to remain at current levels, and prices to remain stable or to decline slightly. It is anticipated that the success of the Soy 20/20 program will lead to the development of alternative markets and thus to a positive stimulation of commodity soybean prices as a result of reduced supply.

Food Grade Soybean Exports to Asia

The sale of food grade soybean from Canada to Asia represents a tremendous success story.

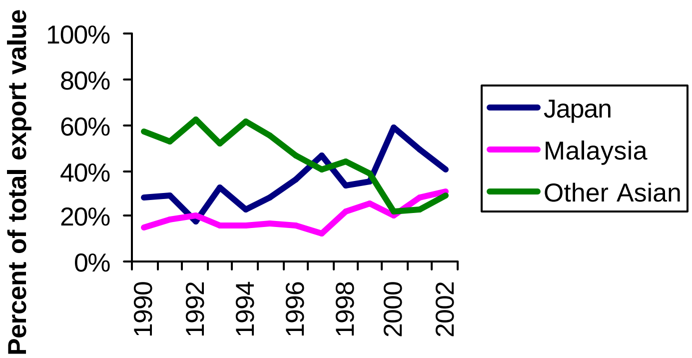
Chart 5: Value of soybean exports to Asia from 1990 to 2002



The Canadian Soybean Export Association (CSEA) was formed in 1995 and has played a significant role in contributing to this success. This success has also been achieved through direct linkages between public and private breeding programs and Asian end users.

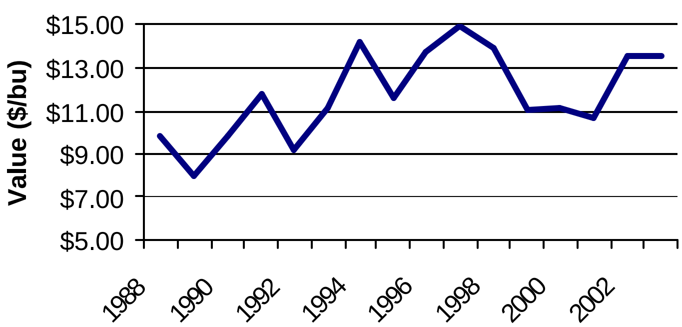
The key markets within Asia have been Malaysia and Japan.

Chart 6: Relative proportion of Asian market attributable to Malaysia and Japan



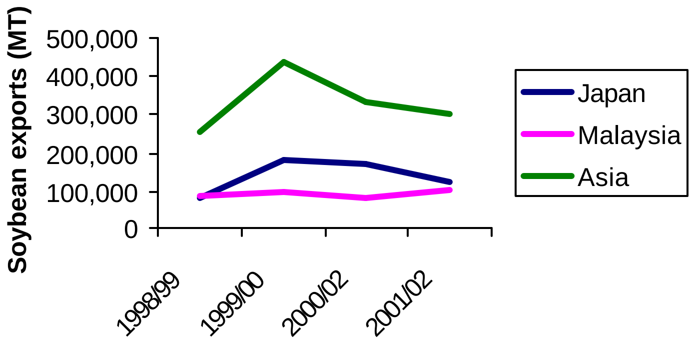
Japan has represented a consistent premium value market over this entire period.

Chart 7: Price paid per bushel of soybean exported to Japan from 1988 to 2003



It is disconcerting to note that the amount of food grade soybean exported to Asia has leveled off in recent years. Soybean exports from Canada to Asia have grown from 77,000 MT in 1989-90 (crop season) to 441,000 MT in 1999-2000 (Statistics Canada), however as can be seen below this volume has dropped in recent years.

Chart 8: Volume of soybeans exported to Asia 1999 to 2002



This is presumably due to a combination of poor growing conditions in Ontario in 2001 and 2002, and increased domestic production of soybeans in Asia. Some of this may also be due to increased growth and marketing of food grade soybeans from the U.S. Canada retains a competitive advantage over the U.S. for food grade soybean exports to Asia for the following reasons (ranked in relative importance)

1.) Superior food grade soybeans
    a. Higher protein
    b. Better functionality
    c. More similar to domestically produced Japanese soybeans
    d. Larger seed size
2.) Credible and reliable identity preservation systems
    a. Reliable delivery of non-GMO soybeans
    b. Reliable delivery of specific cultivars
3.) Lower premium required to stimulate production
    a. Lack of production subsidies increases attractiveness of premiums
    b. Low Canadian dollar vs. U.S. dollar reduces cost to purchaser
4.) First mover advantage
    a. Strong personal relationships established between Canadian exporters and breeders and Asian importers and end-users
5.) Concentrated production in a relatively small area
    a. Able to deliver large quantities of single cultivars
    b. Able to cost-effectively collect large quantities of single cultivars
6.) Integrated value chain approach
    a. Value chain works well together from soybean breeders to farmers to grain purchasers to market agents.

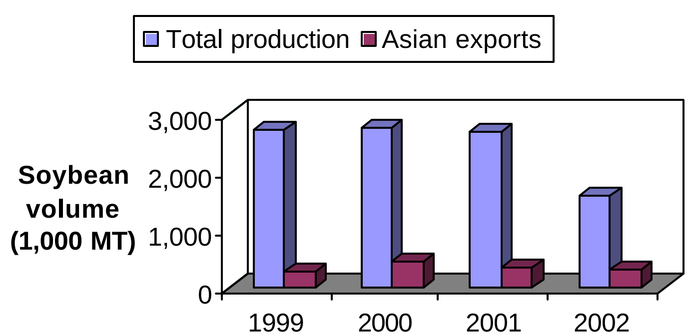
Competitive risks to this market are as follows (ranked in order of relative importance).

1.) Increase in value of Canadian dollar vs. U.S. dollar
2.) U.S. improving marketing ability
    a. Political leverage used for market opportunities
    b. Marketing system improving by building value chain linkages
3.) Argentine and/or Brazil developing significant food grade soybean programs

These are significant threats as these geographies could compete effectively with Canada on the basis of price. However, they will have difficulty competing with the Canadian environmental effect on protein content. In addition, the target market in Asia will continue to grow due to increases in population and per capita wealth.

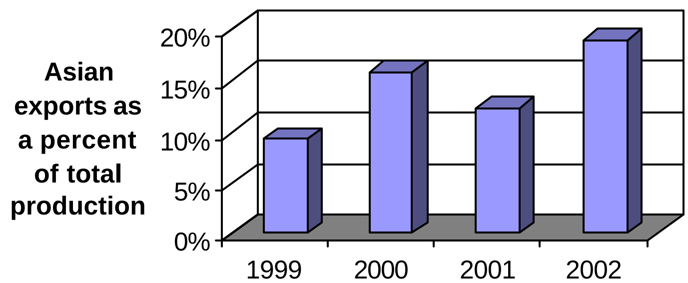
Thus, Soy 20/20 estimates that the most likely scenario for the future is that Canada will be able to maintain its current level of food grade soybean exports to Asia, and that it is more probable that this level will increase in the future rather than decrease.

Chart 9: Relative amount of Asian exports to total Canadian soybean production in recent years



Canadian soybean exports to Asia represent a significant proportion of total crop production.

Chart 10: Percentage of total Canadian production exported to Asia

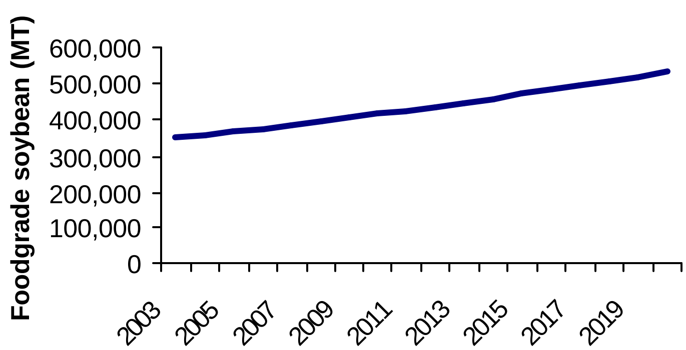


Although exports of the 2001 crop to Asia were lower in volume over previous years, the fact that this market was retained at the level that it was is remarkable. The retention of this market is a strong indicator of its stability and potential for the future.

Soy 20/20 Estimation of Future Market Growth and Value

Soy 20/20 estimates 2.5% annual growth potential in food grade soybean exports to Asia, starting at a base of 350,000 MT in 2003 and continuing to 2020. At an average premium of $1.00/bushel, and a base profit margin of $1.39/bushel without the premium, this represents a net present value for Asian exports of Canadian food grade soybean of $398 M (6% discount rate).

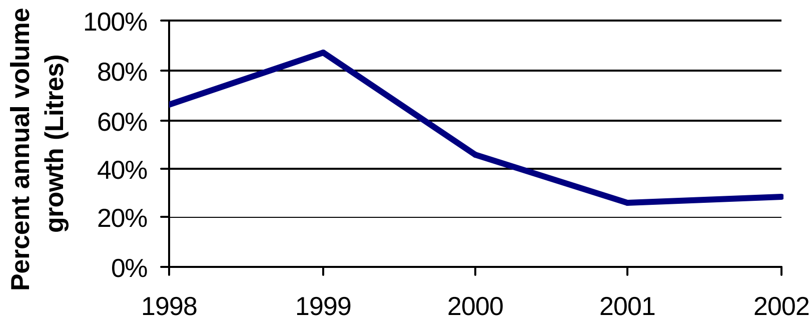
Chart 11: Projected volume of food grade soybean exports to Asia from 2003 to 2020



Domestic Soyfood Markets

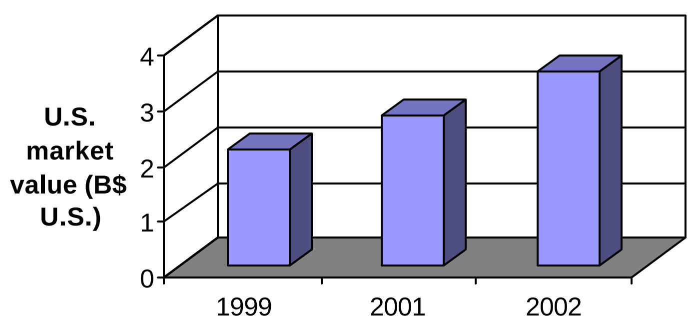
Soyfoods have represented one of the fastest growing food markets in North America over the past five years. Soy beverages have demonstrated extremely strong and sustained growth in Canada.

Chart 12: Growth of soy beverage sales in Canada expressed as a percentage increase from one year to the next



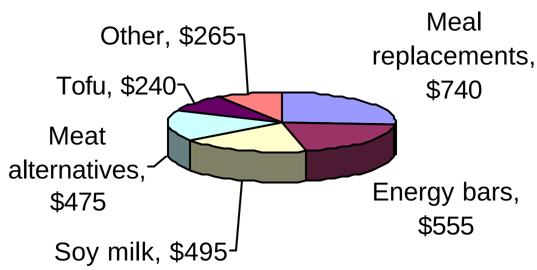
Broad based data on soyfood markets within Canada were not available thus our estimates are based on U.S. data. In the last two years the U.S. soyfood market has increased by 28.6% and 29.6% respectively.

Chart 13: Growth of the U.S. soyfood market in recent years



This market was distributed in the U.S. in 2001 as follows;

Chart 14: Distribution of U.S. soyfood market by market sector and value in 2001



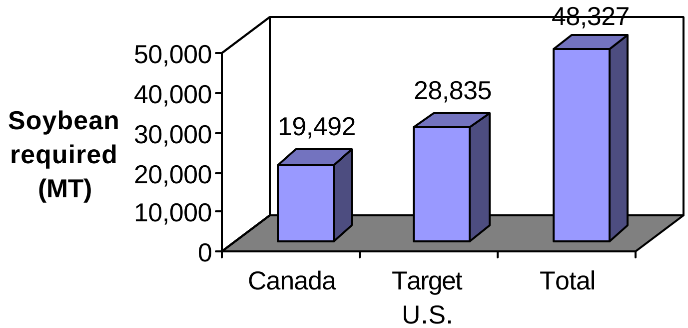
We think that the most effective way to analyze this market opportunity is to focus on per capita soy protein consumption. This enables us to circumvent analyses of each individual market segment and allows direct translation into soybean grain usage. The relative amount of soy protein used in any given product varies both across market segments and within market segments. Per capita soy protein consumption is more than twice as high in Canada as compared to the U.S.

Table 1: Per capita soy protein consumption in Canada and the U.S. on a daily basis

	Per capita soy protein consumption/day
Canada	0.68g
U.S.	0.32g

The world average is 2.36 g/day. If we translate per capita protein consumption into demand for soybean using 36% protein as a basis (decreased 40% or higher to account for losses during extraction) we generate the following estimated production needs for Canadian soybeans. The target U.S. market refers to that portion of the U.S. that lies within one days trucking distance of southwestern Ontario.

Chart 15: Volume of soybean required to satisfy domestic soyfood market

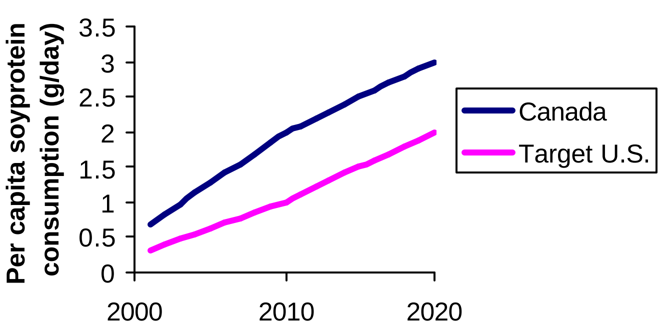


We calculate the total current market value of this opportunity at $1.7 M for the Canadian market, $2.5 M for the target U.S. market, and $4.2 M for the entire market. These values assume the use of food grade soybeans in all products at a premium of $1.00/bushel, and a base profit margin for soybean production of $1.39/bushel. The total current targeted domestic soyfood market represents approximately 14% of the Asian market, and approximately 2% of the total soybeans produced in Canada.

Future Potential for Domestic Soyfood Market

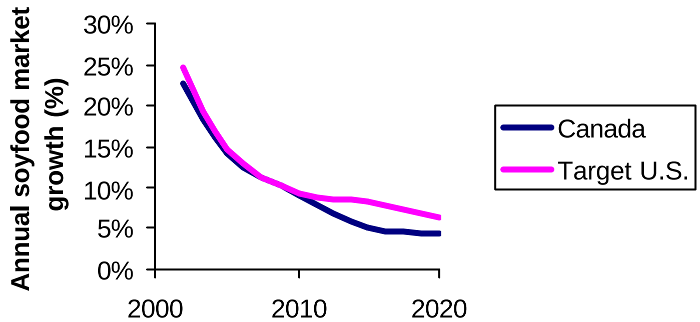
The current North American market is much less significant than the current Asian market, however the domestic market, as discussed above continues to exhibit very strong growth. Soy 20/20 has projected future growth potential of this market on a per capita daily soy protein consumption basis.

Chart 16: Projected increases in per capita soy protein consumption in Canada and the U.S.



These estimates are based on achieving per capita consumption rates of 2.0 g/day in Canada and 1.0 g/day in the U.S. by 2010, and further increasing per capita consumption to 3.0 g/day in Canada and 2.0 g/day in the U.S. by 2020. These estimates may seem high at first, but they are in alignment with current soyfood market growth rates in North America.

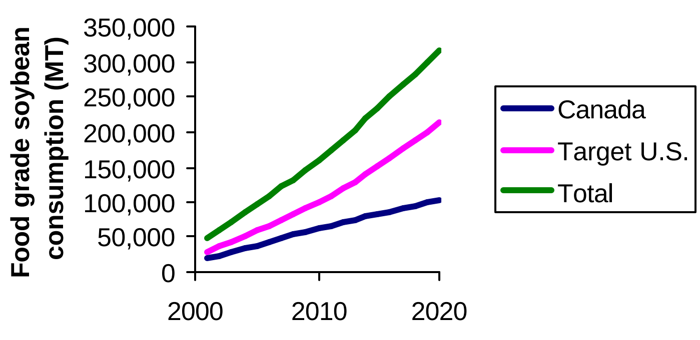
Chart 17: Projected soyfood market growth in Canada and the U.S.



The chart above provides an estimate of total soyfood market growth in the future based on the per capita soy protein increases estimated above. Given that soyfood market growth was greater than 25% in 2001 the projections do appear reasonable. As the soyfood market grows a larger volume increase is required to maintain the same percent level of increase. A 5% market increase in 2020 will be of significantly more value than a 25% increase in 2002.

The market growth projections that we have estimated translate into significant increased demand for food grade soybeans. We are not separating growth in traditional soyfood markets from growth in the use of soy protein as a food ingredient. Both of these markets will contribute to growth in per capita soy protein consumption. It is difficult to develop a workable definition of the different markets. Soy milk is a traditional soyfood, however the actual content of soy protein in this product is in the same range as that of some soy protein fortified breads. Thus, we have decided not to attempt to differentiate these markets.

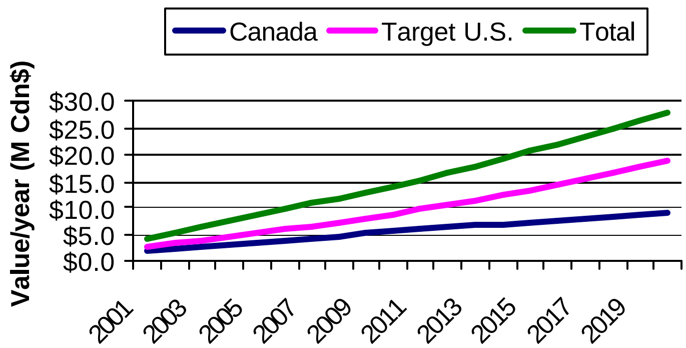
Chart 18: Projected demand for soybeans for domestic soyfood market in Canada and the U.S.



The key driver in terms of generating value from increased per capita consumption of soy protein will be to provide germplasm that provides a functional benefit to the food product it is delivered in.

It is anticipated that initial market demand may be met to a certain extent by commodity soybeans, however, as the market matures, the use of soybean grain that exhibits added value for the processor or the consumer will eventually predominate. Thus, this opportunity comes with a challenge. The opportunity will definitely become significant, the challenge will be to develop and deliver value added soybeans produced in Canada into this market.

Chart 19: Projected value generated by growth in domestic soyfood market for Canadian soybean producers



This market opportunity has a net present value from 2003 to 2020 at a 6% discount rate of $157 M. By the year 2020 given no increase in Canadian production levels, this market would represent 12.8% of total soybeans produced in Canada.

Bio-diesel

Introduction:

Bio-diesel is manufactured from degummed soybean oil through the addition of methanol and an appropriate catalyst. Soybean oil is composed of triglycerides, a glycerin molecule with three long chain fatty acids attached. The catalyst facilitates the transfer of each fatty acid from its attachment to the glyceride to an attachment to the methanol molecule, thus forming three methylesters from each triglyceride. This process also liberates the glycerin molecule from the fatty acids thus resulting in glycerin as a co-product of methylester synthesis. Vegetable oils produced by different plant species have different relative distributions of fatty acid chain lengths. These fatty acids also differ among species in relation to their level of saturation, the number of double bonds they have between carbon molecules along the chain. These differences result in functional differences in the properties of the bio-diesel generated.

Table 2: Functional properties of various bio-diesel formulations

	Diesel	Rapeseed	Canola	Tallow	Soybean
Cloud point C^0	-12	0	1	16	3
Iodine value		91.9	102.8	49.1	103.6

The cloud point of a bio-diesel fuel is an indication of its flowability at low temperature. The iodine value is a measure of the degree of fatty acid oxidation, and as such is an indicator of the potential stability of the fuel. Higher iodine values reflect lower fuel stability. Thus bio-diesel made from rendered animal fats (tallow) has poorer cold temperature flow-ability compared to bio-diesel made from vegetable oils, but can be stored for much longer periods of time without a loss of functionality. The values provided above were derived from 100% bio-diesel formulations. In practice, due in part to the difficulties discussed above, and in part to economic reasons, bio-diesel is generally commercially used in blends of 5 to 20% bio-diesel/diesel.

The key technical advantage to bio-diesel blends is a reduction in the level of pollutants emitted after burning.

Table 3: Bio-diesel emissions:

Emission	B100	B20
Total unburned hydrocarbons	-67%	-20%
Carbon monoxide	-48%	-12%
Particulate matter	-47%	-12%
NOx	10%	2%
Sulfates	-100%	nd
Polycyclic aromatic hydrocarbons (PAH)	-80%	-13%
nitrated PAH	-90%	-50%
Ozone potential	-50%	-10%

Currently sulphur is added to diesel fuel to obtain a necessary level of lubricity. The addition of 1 to 2% bio-diesel provides an equivalent amount of lubricity thus enabling the removal of sulphur. The U.S. government has mandated lower levels of sulphur in diesel fuel by 2006, and the Canadian government has indicated that it will as well.

In addition, bio-diesel fuel has a higher cetane level than diesel fuel.

Table 4: Cetane levels of various bio-diesel formulations

	Diesel	Rapeseed	Canola	Tallow	Soybean
Cetane	49.2	61.8	57.9	72.7	54.8

This allows diesel fuel refiners to reduce the use of costly additives when formulating premium fuels through the use of bio-diesel blends.

Economic Analysis of Bio-diesel Manufactured From Soybeans

The following tables present current cost point analysis for a bio-diesel manufacturing process starting with whole soybeans and using current prices.

Table 5: Current soybean prices

Prices		
Grain price	$8.72	$/bu
Soymeal price	$0.13	$/lb
Soy protein concentrate price	$0.20	$/lb
Soy oil price	$0.32	$/lb
Soy oil price	$0.64	$/L
Diesel price	$0.38	$/L
Glycerin price	$0.50	$/lb
Ethanol price	$0.35	$/L

Prices for both soybean grain and soy oil are currently substantially higher than five year averages. The difference in value per lb between soy protein concentrate and soymeal is strictly a translation of the increase in protein content in soy protein concentrate. Our cost point analysis is based on an analysis of a bushel of soybean. This allows us to be sensitive to changes in soybean prices directly and facilitates clear estimates of the relative amounts of various components that are extracted from a bushel of soybean in practice, rather than in theory.

Table 6: Relative amounts yielded by various soybean subcomponents

Yields		
Soy meal protein content	48%	fresh weight
Soy protein concentrate protein content	70%	fresh weight
Protein difference between SPC and soymeal	146%	
Soy meal yield	47.50	lbs/bu
Soy protein concentrate yield	30.10	lbs/bu
Oil yield	11.35	lbs/bu
Soy oil yield	5.66	L/bu
Soy carbohydrate yield	17.40	lbs/bu
Glycerin yield	1.135	$/lb

Soy protein concentrate is extracted from soymeal by washing the soymeal with a 60 to 70% aqueous ethanol solution.

The costs of extracting the components listed above are provided below. These costs represent operating costs/bushel, and do not include depreciation for capital investment.

Table 7: Operating costs for soybean component extraction and bio-diesel manufacture

Costs		
Crushing cost	$0.07	$/bu
Cost of bio-diesel production	$0.11	$/L
Incremental cost of SPC extraction	$0.10	$/bu

The cost estimated for bio-diesel production listed above is based on the Biox process and represents operating cost per litre of bio-diesel produced. This cost does not include depreciation for capital investment. The Biox process has a lower operating cost than other traditional processes. Other processes have an operating cost of at least $0.15/L of bio-diesel produced.

The province of Ontario has exempted bio-diesel from their $0.143/L diesel tax. In addition, the federal government has exempted bio-diesel from their $0.04/L diesel tax.

Table 8: Relative value of bio-diesel with diesel after tax exemptions

Tax calculation		
Biodiesel tax exemption	$0.183	$/litre
Oil price necessary for competition with diesel	$0.38	$/L
Bio-diesel price justified by tax exemption	$0.56	$/L

We assume that the value of these tax exemptions would be captured by the bio-diesel manufacturer, such that the retail price for bio-diesel fuel would be the same as diesel fuel after taxes. In the model above, diesel fuel is currently selling at $0.38/L. A retailer would need to add $0.183/L in taxes to the retail pump price, or at least $0.56/L. This means that a bio-diesel manufacturer could sell bio-diesel fuel to the same retailer for $0.56/L because the retailer does not need to add taxes to the bio-diesel fuel. Both products would retail at $0.56/L. This calculation does not include retail profit margin, but this is irrelevant to the exercise at hand because this profit margin would presumably be the same regardless of the fuel being sold. Bio-diesel fuel would be sold as discussed above, as a 5 to 20% blend with diesel fuel, and the tax exemption would only apply to that portion of the fuel that contains bio-diesel. However, given that bio-diesel will replace diesel fuel 1:1 on a volume basis the above calculation and argument still apply.

Table 9: Estimation of operating margin for bio-diesel production from a bushel of soybean

Output proportions	Volumes	Value
Bushels of soybean	1.0	$8.72
Litres of bio-diesel	5.7	$2.73
Litres of ethanol	1.2	$0.41
Kg of soy protein concentrate	13.7	$6.11
Kg of glycerin	0.5	$0.57
Operating cost		$0.79
Gross revenue		$9.82
Net operating revenue		$0.31

Thus bio-diesel can be produced from soybeans at an operating profit. This model requires value generation from four co-products. The key difference between this model and more traditional analyses of bio-diesel value is that we have extracted soluble sugars (in particular sucrose) from the soy meal and converted it into ethanol. This results in two co-products ethanol, and soy protein concentrate. The incremental operating cost of performing this extraction is negligible compared to the added value provided to the model. In addition, the co-product values that we have estimated for ethanol production and soy protein concentrate are conservative.

Soybean contains on average 7.3% sucrose, 4.1% stachyose and 0.6% raffinose. It is possible that a portion of the stachyose and raffinose extracted in the soluble carbohydrate fraction would be fermentable but we are confining our analysis to the sucrose portion. Sucrose is directly fermentable by yeast, at an operating cost of less $0.01 per litre of ethanol produced. Ethanol production from corn starch requires the use of desachrifying enzymes that add an additional operating cost $0.04/litre of ethanol produced.

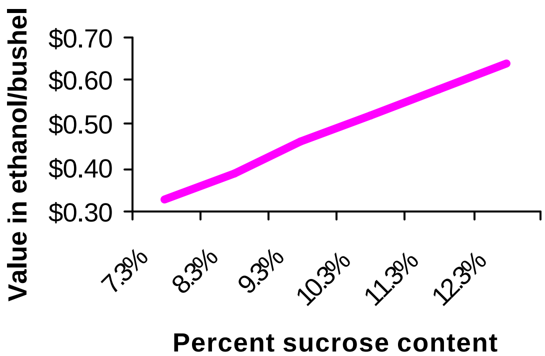
Table 10: Soybean sugar value calculations

Value of soybean sugars		
Sucrose %	7.3%	% of seed fresh weight
Sucrose mass (lbs)	4.38	lbs/bu
Sucrose mass (kg)	1.99	kg/bu
Practical efficiency of ethanol production	0.514	g ethanol/g glucose
Amount of ethanol produced per bushel of soy	1.02	kg/bu
Volume of ethanol produced per bushel		
Conversion mass to volume	1.15	L/Kg
Soy ethanol yield	1.18	Litres/bu
Cost of soy carbohydrate extraction/bushel	$0.10	$/bu
Cost of soy carbohydrate extraction/Litre ethanol	$0.08	$/Litre
Value of sucrose content/bushel	$0.33	

The value of the soy protein concentrate has been estimated as a soy meal feed replacement (after adjusting for the higher protein content). Soy protein concentrate (SPC) is currently used as a food ingredient for much higher prices. The oligosaccharides, stachyose and raffinose are not digested in non-ruminant stomachs thus leading to flatulence. The removal of these components from soymeal should thus increase the value of the protein.

The level of sucrose present within soybean is known to vary considerably. Higher levels of sucrose will not have an effect on the cost of extracting them, thus there is a more than linear positive value in the selection of soybean varieties with higher levels of sucrose for bio-diesel production.

Chart 20: Increase in ethanol value as a result of increases in sucrose content in soybean

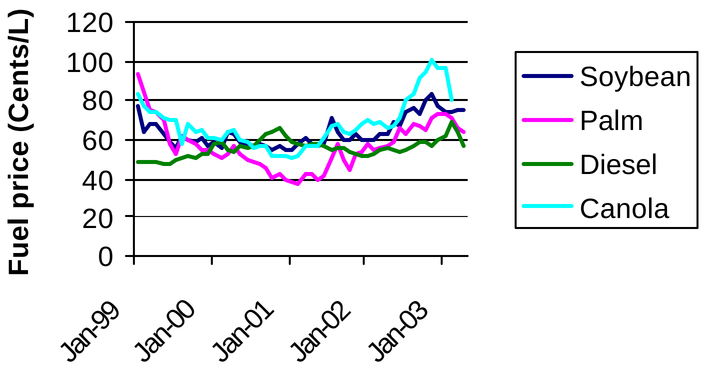


Comparative Value of Various Bio-diesel Formulations

The cost of the feedstock is the primary variable in determining the economic feasibility of bio-diesel manufactureing. In our calculations above we have based the price for bio-diesel on the wholesale diesel price. This is independent of the market price for soybean oil. If, as currently is the case, the market price for soybean oil is higher than the potential value in bio-diesel there is an implicit opportunity cost. This opportunity cost is offset by the co-product value of an integrated bio-diesel/ethanol manufacturing process. In the following analysis we will consider a bio-diesel manufacturing plant that simply purchases vegetable oil as a substrate. In this instance, how competitive is soybean oil versus other vegetable oils?

Bio-diesel can be manufactured from any vegetable oil source, and at low percentage blends the difference in functionality will be minor (Tables 2 and 4). We analyzed comparative bio-diesel prices versus wholesale diesel prices over the last four years.

Chart 21: Comparison of bio-diesel prices from various vegetable oil sources with wholesale diesel prices over the last four years



Bio-diesel prices were calculated based on monthly vegetable oil market prices translated into Canadian dollars for each month's respective currency rate. A cost of $0.11 per litre was added to each respective vegetable oil price to estimate a wholesale bio-diesel price. The diesel prices are based on a translation of spot wholesale diesel prices quoted for New York harbour converted to wholesale Canadian prices through the appropriate monthly currency rate calculation coupled with a translation upwards through the use of the following formula;

$S + (1/S) \times 100$

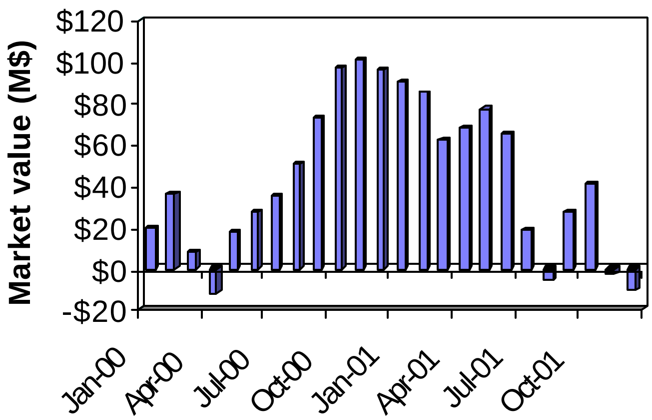
Where S = the New York harbour spot price.

This formula was developed by Soy 20/20 as a best fit to available data.

It is clear that a bio-diesel manufacturing plant that relied on direct purchase of soybean oil at market prices would not have been cost competitive with wholesale diesel prices except for a brief period late in the year 2000 and early in 2001. The market price for canola oil generally tracks higher than soybean oil. We consider rapeseed oil at the same price as canola oil, as any farmer growing rapeseed would not be realizing the potential price for canola oil. The market price for palm oil is interesting in that it exhibits two types of variation. On the one hand it exhibits a strong, slightly delayed response to soybean oil prices. On the other hand it is more volatile with a four to five year oscillation period. One potential reason for this oscillation in palm oil prices is the implicit five year delay between tree planting and oil harvesting. When the market price for palm oil is increasing additional trees are planted, but this incremental capacity does not become available for five years, at which point over supply depresses prices. The average palm tree remains productive for an average of 25 years. A cyclical stimulus is also provoked when orchards are taken out of production.

If bio-diesel made from palm oil was available in the market period analyzed above it would have been competitive with diesel prices for at least half the time. In a market where bio-diesel sold for a lower price than diesel, demand for bio-diesel would exceed supply. We assume that the maximum market penetration in regard to maintaining engine warranties and maintaining acceptable cold flow properties would be a 20% bio-diesel/diesel blend. In this scenario, the total market opportunity for bio-diesel based on palm oil for the Canadian trucking industry would have exceeded one billion dollars from January 1st, 2000 to December 31st, 2001.

Chart 22: Monthly value difference of a 20% palm based bio-diesel blend versus diesel fuel for the Canadian trucking industry for the years 2000 and 2001



It is clear that feedstocks other than vegetable oil, such as rendered animal fat and yellow grease, will be the primary drivers of bio-diesel production for economic reasons.

Table 11: Comparison of feedstock prices for bio-diesel manufacture

Feedstock prices	$/lb
Tallow	$0.07
Yellow grease	$0.11
Soybean oil	$0.32

Tallow is a form of rendered animal fat, and as we saw in Table 2, the functional performance of bio-diesel made from tallow is significantly different than the performance of vegetable oil based bio-diesel. Tallow based bio-diesel has a much higher cold point (16^{o}C as opposed to 3^{o}C for soybean based bio-diesel). In blends up to 10% bio-diesel, this difference will only amount to a lowering of the cold point by one degree. Bio-diesel blends of 20% made from rendered animal fat, will, however, have a three degree higher cold point than blends from vegetable oil.

Bio-diesel Market Potential

Primary market opportunities for bio-diesel will be at low percentage blends (2 to 5%). These blends achieve some reduction in pollutant emissions, enable significant sulphur reductions, and minimize engine warranty concerns, while still enabling the marketing of a premium quality fuel. We have limited our market analysis to the Canadian trucking industry. The marine and rail use of diesel represents a significant portion of the diesel market, however, these markets are currently allowed to use cruder diesel blends at a lower cost than the diesel fuel required for the trucking industry. Thus, we consider rail and marine markets as secondary markets that will only be penetrated as a result of government regulations reducing the level of pollutants these industries are allowed to emit.

Chart 23: Total diesel fuel sales in Canada

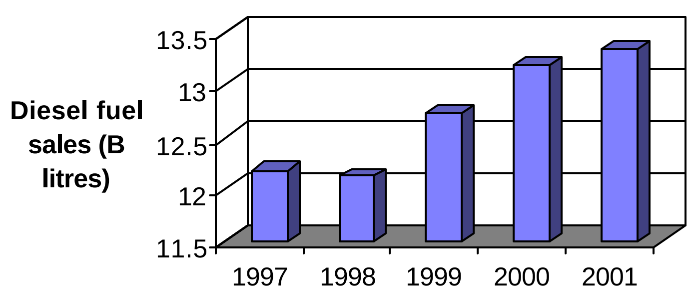
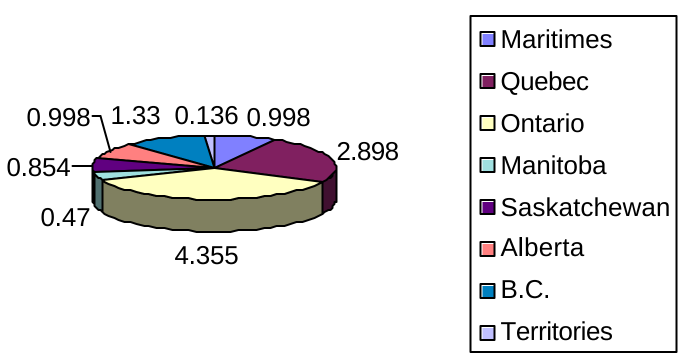
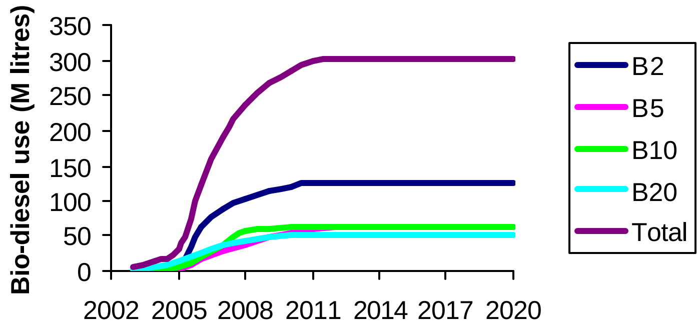


Chart 24: Distribution of diesel fuel sales in Canada by province (2001)



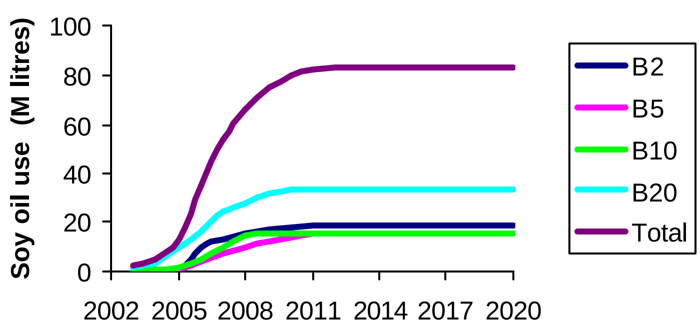
Values are in billions of litres.

Chart 25: Estimated market penetration for bio-diesel blends



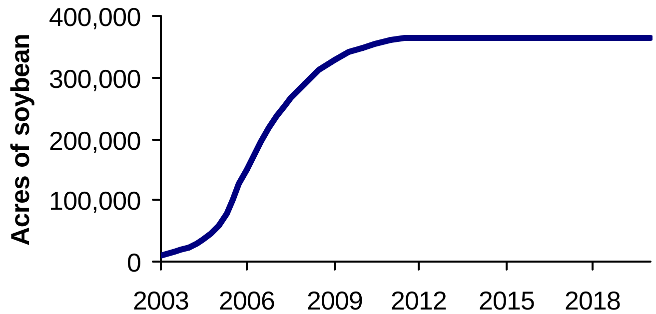
Given the above discussion of economic and technical considerations of bio-diesel feedstock blends, the opportunity for soybean based bio-diesel is obviously higher in higher percent blends.

Chart 26: Soybean oil use in various bio-diesel blends



The estimates derived in Chart 26 can be used to determine the impact of soybean oil use in bio-diesel on demand for soybeans in Canada. Translations to soybean usage were calculated on the basis of 18% oil, and yields of 40 bushels per acre.

Chart 27: Impact of bio-diesel use on demand for Canadian soybeans



This represents a peak demand for 364,000 acres of soybean. We have not allowed for market growth in this model. It is reasonable to assume that the trucking industry will continue to grow, it is unclear how much impact increased fuel efficient motors will have on the growth in diesel demand.

We have analyzed the potential value that the production of this amount of bio-diesel from soybean would have for a bio-diesel manufacturing plant.

Table 12: Balance sheet for projected soybased bio-diesel production

Output proportions	Volumes	Value
Bushels of soybean	14,558,631.5	$126,660,094.23
Litres of biodiesel	82,364,730.2	$48,018,637.74
Litres of ethanol	17,136,798.6	$6,031,309.92
Kg of soy protein concentrate	198,771,130.1	$87,714,519.36
Kg of glycerin	7,495,190.5	$4,957,214.03
Operating cost		$11,535,087.69
Gross revenue		$146,721,681.05
Net operating revenue		$8,526,499.14
% net revenue of operating costs		6%

The estimated 14 million bushels of soybean used to produce bio-diesel would require 363,966 acres to produce. We assume that the purchase of these soybeans would create increased demand for domestically produced soybeans. This increased demand would translate into a premium amounting to at least the cost of transporting U.S. grown soybeans into Canada. We are currently estimating this cost as $0.20/bushel. Therefore, we estimate a potential combined value of a soybean based bio-diesel plant operating in Canada equaling $8.5 M from bio-diesel operations per year, and $23.1 M in on farm value per year. This latter value is calculated by multiplying the bushels used (14.5 M) by the sum of the current operating profit per bushel of soybean ($1.39/bu) and the transportation premium ($0.20).

Bio-diesel Summary

The production of bio-diesel from soybean has not occurred to date in Canada because of a previous lack of bio-diesel tax exemptions and a reluctance on the part of petro-chemical companies to enter into the market. The introduction of both federal and provincial tax exemptions coupled with government intentions of mandating ultra-low sulphur diesel fuel regulations have made bio-diesel manufacturing more attractive. The capital investment in manufacturing capability is offset by the ability to hedge diesel prices through the use of different feedstocks. This flexibility has been greatly enhanced by the Biox patented bio-diesel manufacturing technology. The use of soybean oil to produce bio-diesel becomes attractive when potential co-products are considered, especially in conjunction with ethanol production. This is a significant market opportunity, and Soy 20/20 will continue to exert considerable effort in working with companies interested in developing Canadian based manufacturing plants.

Soybean Peroxidase

Soybean seed coats or hulls have a protein content of 0.5% and are added back to soymeal following oil extraction to increase the fibre content of the meal. This provides a value to soybean hulls equal on a per weight basis to soymeal. Soybean peroxidase represents 3% of the total protein content of soybean seedhulls. Horseradish peroxidase has been used widely in a broad range of diagnostic kits, coupled with glucose oxidase as a colour indicator. Soybean peroxidase is more heat stable than horseradish peroxidase and thus provides a functional improvement for commercial applications. We have used the available data to determine the relative value of soybean peroxidase per bushel of soybean. Unfortunately, we have not yet been able to determine the cost of commercially extracted soybean peroxidase, but we have provisionally estimated it at $250.00/bushel for pharmaceutical grade peroxidase.

Table 13: Calculation of amount of soybean peroxidase extractable from soybean hulls

Soybean peroxidase inputs		
Cost of soybean grain	$8.50	$/bu
Soybean hull yield	1.15	lbs/bu
Peroxidase concentration	3%	% of total protein
Extractable total protein in seed hulls (0.5%)	5	g/kg of hulls
Extractable total protein in seed hulls (g/bu)	2.61	g/bu
Peroxidase extracted from hulls/bu	78.24	mg/bu
Cost of peroxidase extraction	$250.00	$/bu

We have used the commercial catalogue price for horseradish peroxidase to estimate the potential market price and market opportunity for soybean peroxidase.

Table 14: Estimated value of soybean peroxidase per bushel of soybean

Value		
Commercial price for horseradish peroxidase	$41.30	$/2,000 units
Activity	250.00	units/mg
Price/mg	$5.16	$/mg
Value of soybean peroxidase	$403.94	$/bu
Operating margin for soybean peroxidase	$153.94	$/bu

These estimates concern a pharmaceutical grade market and as such while the margins are compelling, the overall volume required would not be expected to be large.

A larger scale, industrial application for soybean peroxidase has been patented by Enzymol International (Ohio). They have been issued U.S. patent number 5,491,085 relating to the use of soybean peroxidase as a substitute for formaldehyde in the formation of phenolic resins. Phenolic resins based on formaldehyde reactions are used to glue fibres together in fibre boards such as plywood and particle board. Currently phenol is reacted with formaldehyde resulting in a phenolic resin. This is not an environmentally friendly reaction, especially as a significant proportion of the formaldehyde is not consumed in the process and must be disposed of as waste or recycled. Soybean peroxidase can be substituted completely for formaldehyde. We have estimated the potential size of this market for Canada.

Table 15: Scale of the soybean peroxidase opportunity in phenolic resins in Canada

Market size		
Resin market (Canada)	374	Kt
Phenolic portion of resin market	32%	
Phenolic resin market (Canada)	119.68	Kt
Phenolic resin market (Canada)	108,572	MT
Peroxidase use (per 100g of resin)	5	Mg/100 g of resin
Peroxidase use (per MT of resin)	50	g/MT
Potential peroxidase use Canadian market	5,429	Kg

The soybean peroxidase used for this application would not need to be as concentrated as it would for the previously analyzed pharmaceutical market. Enzymol International has also demonstrated that a simple freezing and thawing of soybean hulls results in almost complete deactivation of other enzyme activities. Soybean hulls following the freeze/thaw cycle can be directly added to phenol. The additional fibre present would simply augment the fibre content of the particle board synthesized. This process reduces the cost of soybean peroxidase extraction to a negligible amount. We have calculated the market value of peroxidase used in this process on the basis of cost competitiveness with formaldehyde. There is 1/4800th as much soybean peroxidase required on a per weight basis to form phenolic resins as compared to formaldehyde, thus if the market price for formaldehyde is $280/MT, then the comparable market price for soybean peroxidase is $1.35/g.

Table 16: Analysis of market opportunity for soybean peroxidase in phenolic resins

Market analysis		
Soybean peroxidase value	$1.35	$/g
Market penetration	40%	
Premium	$0.10	$/bu
Soybean required	27,682,815	bushels
Soybean required	753,404	MT
Soybean acres required	820,185	acres
Value	**$2,768,281**	$/year

At this point this market would possess no incremental value for Canadian soybean producers, as the processors would be purchasing soybean hulls directly from crushers. There is potential to create value for producers by increasing the amount of soybean peroxidase expressed in the seed coat. Given the estimated low cost of extraction, the market driver for increasing soybean peroxidase levels would be limited availability. It is difficult to estimate the potential value of such a premium at this point in time as it would be set by competition among companies for access to feedstock. Given a value of $0.11 per bushel at the current expression level of 78.44 mg/bu, a doubling of expression level would increase value by $0.10/bushel. In a competitive model this entire value would be shared by the producer and whomever owns or delivers the increased expression level. This incremental value would equal a net present value of $18.7 M given market entry in 2004, and peak market penetration (40% of the market opportunity) ten years after market entry.

Wax Candles

Through a process of partial hydrogenation it is possible to raise the melting point of soybean oil, such that it is solid at room temperature (this is referred to as a wax). The majority of candles are made from paraffin wax. Paraffin is derived from petroleum. Soy wax candles will burn up to 30% longer than paraffin candles, can accommodate more fragrance (up to 10% on a by weight basis as compared to 6% for paraffin) and do not emit noxious petroleum based pollutants. Soy wax can be formulated and marketed at a similar price to paraffin for container candle wax, but is currently marketed at a significant premium for free standing candle wax (votives and pillars).

Table 17: Market price comparison between soy wax and paraffin

	Paraffin	Soy wax
Container blend	$0.83/lb	$.83/lb
Free standing blend	$0.90/lb	$1.66/lb

The scale of the Canadian candle market is significant in terms of wax volume consumed annually. We estimated volume by multiplying available U.S. data by 10% and using the average price of votives as a basis for converting price to volume.

Table 18: Size of candle market opportunity in Canada

Inputs		
Total U.S. retail candle sales	$2,800	M U.S. $
Canadian market size relative to U.S.	10%	
Soy wax candle market penetration	10%	
Soybean oil yield	11.35	lbs/bu
Specific weight of soy oil	0.91	L/Kg
Soybean yield	40	bu/acre
Canadian/U.S. $ conversion	1.3851	
Votive candle price	$1.22	each
Weight	0.125	lbs
Market penetration of votives in Canada	41%	

Votives are small free standing (non-container based) candles that are generally sold in packs of four or more. They represent the most dominant portion of the candle market.

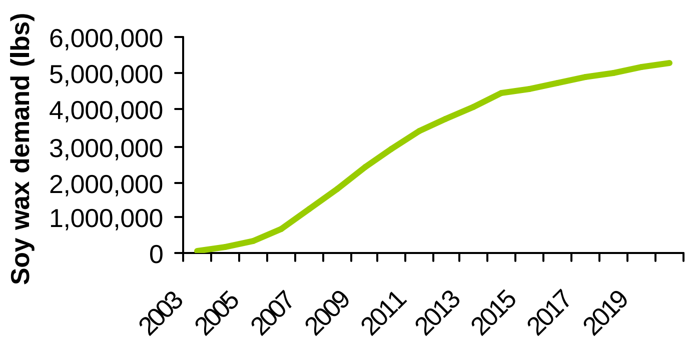
Table 19: Size of soy wax candle market opportunity in Canada

Calculations		
Value of candles (per lb)	$9.76	$/lb
Size of U.S. market	287	M lbs
Size of Canadian market	29	M lbs
Size of Canadian soy wax candle market	2,868,852	Lbs
Value of Canadian soy wax candle market	$38,782,800	cdn $
Amount of soybean oil required	2,868,852	lbs
Amount of soybeans required	252,762	bu
Acres required	6,319	acres

Soy wax candles is an attractive market as an alternative value added use of soybean oil. Candles represent the largest potential market opportunity for soy wax, but there are significant additional opportunities for use in cosmetics and air fresheners. To make soy wax requires hydrogenation equipment, which requires a capital investment of approximately $300,000. The margin available for soy wax coupled with the potential size of this market justifies this expenditure.

Based on the assumptions discussed above we have estimated soy wax candle market penetration in Canada as peaking at 10% of the total candle market.

Chart 28: Estimated soy wax candle market penetration in Canadian candle market



The total net present value of this opportunity for soybean producers is estimated at $4 M from now until 2020. We have not estimated the value for the candle manufacturers as this will largely represent a cannibalization of the existing paraffin candle and thus not represent incremental value to the Canadian economy.

Polyurethane Foam

Soy oil and soy protein has been technically demonstrated as a potential substrate for the manufacture of a wide variety of plastic products. Polyurethane foam production from soy oil represents the most mature of these opportunities. Polyurethane foams are produced by combining isocyanates with polyols. Polyols are produced from petroleum. Soy based polyols can be produced at a price competitive with petroleum based polyols ($0.50 to $0.70/lb). Polyurethane foams are primarily used in construction.

Table 20: Characterization of target market for soy based polyurethane foam

Target market scale		
U.S. foam market	2,600	M lbs
Canadian foam market	290	M lbs
Target U.S. foam market	912	M lbs
Soy market potential	27%	

The estimates above translate into a significant market opportunity for Canadian soybean production.

Table 21: Estimated market opportunity for Canadian production of soy based polyurethane

Market opportunity		
Canada	30%	
U.S.	10%	
Canadian soy based polyols	23.44	M lbs
U.S. soy based polyols (target market)	24.56	M lbs
Total market	48.00	M lbs
Total market	21,774	MT
Soy production required	115,106	MT
Value of market	$24,002,039	cdn $

The target U.S. market is composed of that portion of the U.S. within one days' trucking distance of southern Ontario. The market penetration estimates may appear conservative, but these estimates relate to the potential market penetration for Canadian production. There is existing U.S. production of soy based polyurethane foam already.

This market opportunity would be significant enough to justify a premium paid to Canadian soybean growers as a result of increased demand. This premium of $0.20/bushel coupled with the existing operating profit margin of $1.39 per bushel results in a net present value estimate for this opportunity of $52 M for producers from now to the year 2020.

Summary

The future for soybean production in Ontario would appear very bright following a perusal of this document. It should be stressed however, that the opportunities outlined herein, are opportunities. To achieve the opportunities as estimated in the charts provided is not inevitable. Opportunities that have not yet been realized in Canada have not been realized simply because of oversight on the part of local entrepreneurs, or a lack of capital investment, or entrepreneurial spirit. There are significant constraints, economic, technical and the presence of foreign owned intellectual property that need to be dealt with first.

We can learn from where we have been competitively successful, and that is in the area of food grade soybean exports to Asia. As outlined above, a key part of that success was the development and ongoing management of the entire value chain. We can use the linkages that have been built to deliver that opportunity and the lessons learned to build the value chains necessary to deliver on the opportunities outlined above. This is not a trivial exercise, it requires the establishment of trust and credibility across all components. It is the intention of Soy 20/20 to act as a crystallization point for building these value chains. Thus, we have attempted to be honest and thorough in building the above estimates. In this spirit we ask anyone reading this document who notices errors or omissions to bring it to our attention.

It is necessary to be humble in the face of data, but also to see opportunity in constraints.