WOODBRIDGE ASSOCIATES™

Canola Oil and Flax Oil

Spray-On Foam ('SPF') Insulation

Commercial Opportunities for Alberta Producers

BUSINESS CASE

Final Report

Prepared for Alberta Agriculture and Rural Development (ARD); Alberta Finance and Enterprise (AFE) and the Alberta Research Council (ARC)

August 2009

Letter of Transmittal

August 28th 2009

Lori-Jo Graham
Project Manager
Green Building Material Team
Opportunity Assessment Branch
Alberta Agriculture & Rural Development
2nd Floor, 50-5030 Street
Olds, Alberta
Canada T4H 1S1

Dear Lori-Jo,

FINAL REPORT

We are pleased to submit our Final Report on the market and commercial potential for Canola oil and flax (linseed) oil grown in Alberta and processed into natural oil polyols (NOPs) in the province of Alberta, aimed at the spray-on foam thermal insulation manufacturers market in North America.

We appreciate the opportunity to carry out this assignment on behalf of Alberta Agriculture and Rural Development (ARD), Alberta Finance and Enterprise (AFE) and the Alberta Research Council (ARC) – and look forward to discussing the follow-up to our report with you and the Project Team at your convenience.

Yours Sincerely,

original signed

Peter Woodbridge
President

(604) 922 4090
pw@woodbridgeassociates.com

Executive Summary

- Canola oil and flax oil can meet part of the rapidly growing demand for 'green' SPFs. Canola oil is a better feedstock prospect than flax for attracting new investment into Alberta for a full scale, commercial polyols plant and for attracting grower interest.
- But this conclusion could change if (a) the technical potential for extensive substitution of natural oil polyols (NOPs), such as flax oil (linseed) indicates that they can widely displace 'non-green' compounds the manufacturing of which creates significant levels of greenhouse gases (GHGs)
- Growth in NOP SPF demand can provide useful additional demand for Canola and flax farmers in Alberta. But this application for the oils is unlikely to offer a 'financial bonanza' to them.
- Moreover, the 'opportunity cost' of these oils is high. Canola (rapeseed) oil has become the #1 vegetable oil in Europe for bio-diesel. It seems probable that many other polyol products apart from SPF insulation may present financially rewarding options for a commercial polyols plant based in Alberta. However, these other products lie outside the scope of work of this study.
- For producers who are interested in a long term commitment to this market opportunity, the best business model would be to focus on a collaborative effort.
- Most likely this could be with a Canadian-based oil extractor already producing a wide range of natural oil polyols – for a variety of markets – and exports to the U.S. Collective market development efforts might best be pursued through the Canola Council of Canada.
- In addition, based on the *Icynene* business model, Alberta could follow-up from this initial business case evaluation by direct discussions with Icynene – to explore the potential for it to use canola oil and/or flax oil produced in Alberta. For example, Icynene's U.S. expansion (assumed) could use canola/flax oil in place of the more readily available (in the U.S.) soy oil (e.g. US West green building market).
- As a cautionary note, consumers do not appear willing to pay significant premiums for NOP-based SPFs. NOPs are at "nice to have" stage of development in SPF products. NOPs currently are not full substitutes for GHG-producing chemicals currently used. However, NOPs provide green market "respectability" to large chemical manufacturing firms.
- A key public policy choice in the future will be whether the insulation industry, and more generally the building materials industry, in North America will self-regulate and introduce enforceable product standards for 'green' products – or will have to be regulated.

Table of Contents

1. Purpose and Scope of Report, Methodology and Acknowledgements

The potential to use natural oil polyols (NOPs) made from Canola oil and/or flaxseed oil (linseed oil) in the manufacturing of compounds and formulations used for spray polyurethane foam (SPF) insulation has been identified, as being of potential interest to Alberta producers of Canola and flax, by the *Green-Building Ag-Based Material **Project Team*** of *Alberta Agriculture and Rural Development* (ARD) and *Alberta Finance and Enterprise* (AFE).

Spray polyurethane foam (SPF) is a spray-applied insulating foam plastic that is installed as a liquid and then expands many times its original size. Spray polyurethane foam can be adjusted and have many different physical properties depending on the use desired. The same basic raw materials that can make insulation foam semi-rigid and soft to the touch also creates high density roofing foam that is resistant to foot traffic and water (source: SPFA website) http://www.sprayfoam. org/index.php?page_id=38 . A sub-set of this market is the emerging demand for eco-friendly thermal insulation products – at which NOPs, including those made from Canola oil and flax oil, are targeted.

The Project Team has commissioned this report to determine if these products *prima facie* are potentially financially viable in an Alberta setting (Exhibit 1, next page). The report assesses the market opportunities, manufacturing requirements and agricultural production conditions required for commercial success. This is a preliminary assessment, presented as a **business case** for the two oils. Further research and analytical work is anticipated by the Project Team. It is intended that the business cases will be presented to private sector firms in Alberta – as product options for them to review. Importantly, ARD, AFE and ARC wish to develop from this report a province-wide commercial strategy that ultimately could assist Alberta-based growers attract potential processing partners, distribution channel partners and investors.

As part of the background to this project and report, the Project Team knows that the green building market in North America is growing rapidly. The Project Team was aware that the market for industrial oils used in spray polyurethane foam (SPF) production already had been developed in North America. Producers of SPF have been identified who use linseed oil and soybean oil as part, or all, of the bio-based content in SPF production. The terms of reference of the assignment was to evaluate the North American market potential for Alberta-produced Canola oil and/or flaxseed (linseed) oil in this specific application. Part of the consideration was the knowledge that, in Alberta and Canada as a whole, Canola (rapeseed) is the most important oilseed produced. In contrast, in the United States, soybean production – and soybean oil – production dominates the oilseeds growing industry. In Canada, flax growing for linseed oil production is a much smaller industry than the Canola industry.

Methodology

Most of the research was carried out through a combination of desk analysis and field work, which included meetings in Canada and the US (notably at the International Building Show IBS 2009) in January 2009. Details of methodology are shown in Exhibit 2. The business case evaluation has been approached from two perspectives:

- *The overall market (and competitive supply) situation for thermal insulation in North America, and*
- *The potential for Alberta-produced Canola oil and/or linseed oil to displace other compounds used in SPF production*

Acknowledgements

The report authors wish to thank Lori-Jo Graham, Project Manager for this project and Lead, Green Building with ARD. Thanks are also due to other members of the Project Team including Trevor Kloeck, Richard Gibson, John Leurdyke and Patti Breland.

Disclaimer

The consultant has made every effort to confirm the data and findings presented in this report, including those based on the information made available by the clients. Nevertheless, all readers of this report who subsequently use the information are responsible for verifying data and findings. The consultant does not accept responsibility for the accuracy of any data which has been provided, nor for any commercial decisions or investments made relating to the report. The views expressed in the report are those of the consultant alone, and do not necessarily reflect the views of the Project Team, ARD, AFE or ARC or any of the individuals or organizations mentioned in the report.

1. Purpose and Scope of Report, Methodology and Acknowledgements (continued)

The approach taken to this assignment was defined in the terms of reference, which sought an independent evaluation of the potential. In particular, a key issue was the question *'Is there a business case for further work on these products?"*

The research was carried out independently via desk analysis and interviews including several carried out with insulation manufacturers and exhibitors at the International Building Show in Las Vegas in January 2009. Separately, a polyols pilot plant associated with the initiative behind this study has been operating in Calgary for some time. Initial research results on polyols, including test results on Canola oil and flax oil, however was not made available for the study.

The study's goal was to ascertain the potential market demand and market share for thermal insulation SPF products being produced in Alberta based on using Canola oil and /or linseed oil. Correspondingly, the focus adopted was to include comparisons of Canola/linseed oils potential in SPFs versus 'non-green' compounds the manufacturing of which may yield GHGs, from a market-driven rather than the linked, but separate, polyols research findings perspective.

Exhibit 1

Project Goals & Background

1. Determine the potential to use canola oil and/or flaxseed oil (linseed oil) in the manufacturing of compounds and formulations used for spray polyurethane foam (SPF) insulation.

2. Evaluate the North American market potential for Alberta-produced canola oil and/or flaxseed (linseed) oil in this application.

Background

This opportunity identified initially as being of potential interest to Alberta producers of canola and flax, by the *Green-Building Ag-Based Material Project Team* of *Alberta Agriculture and Rural Development* (ARD) and *Alberta Finance and Enterprise* (AFE).

Producers of SPF have been identified who use linseed oil and soybean oil as part, or all, of the bio-based content in SPF production (*Icynene; linseed: Envirofoam; soy*)

In Alberta, and Canada as a whole, canola (rapeseed) is the most important oilseed produced. In contrast, in the United States, soybean production – and soybean oil – production dominates the oilseeds growing industry – and is the key oil used in USA.

In Canada, flax growing for linseed oil production is a much smaller industry than the canola industry.

Exhibit 2

Research Approach

Key issue: is there a business case for further work on these products?

Method:

Determine the overall market (and competitive supply) situation for thermal insulation in North America, and

Evaluate the potential for Alberta-produced canola oil and/or linseed oil to work alongside or displace other compounds used in SPF production

- Chlorine based compounds …. CFCs (all SPF's are now non-CFC)
- Other reaction gases (foaming agents that form cell structure)**
- Soybean oil used in the U.S.

Research carried out independently via desk analysis and interviews (e.g. IBS 2009). A polyols manufacturing pilot plant, located in Calgary, is associated with the initiative behind this study. However, the plant's research findings were not made available.

** Hydrofluorocarbon HFC-245fa (Honeywell); ammonium, sodium bicarbonate, complex nitrogen

North American Market for Thermal Insulation

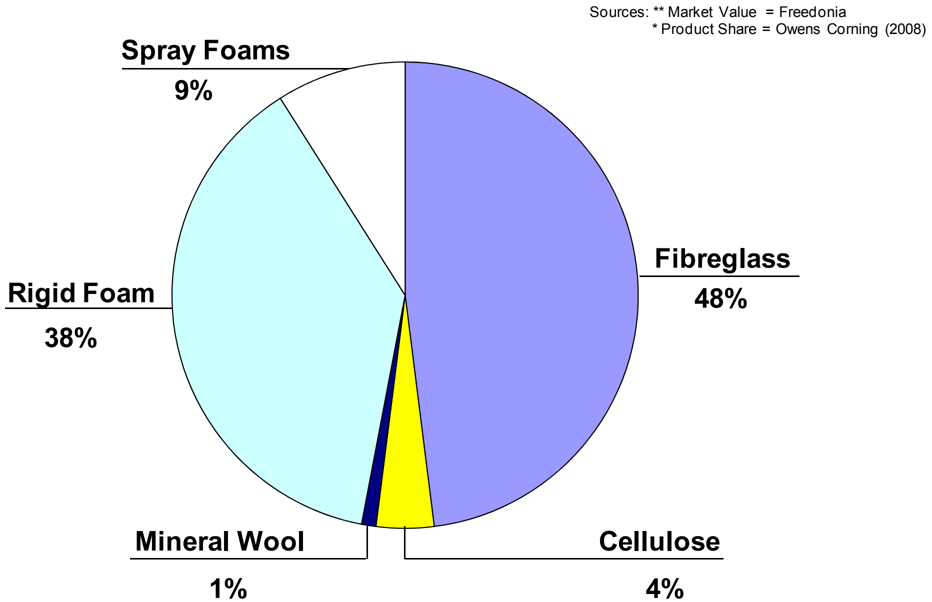
2.1 Market Segments

2.1 Thermal Insulation Market Segments

Exhibit 3

North American Insulation Market: Product Share*

Total Market Value = US$8.5 Billion (2008)**



Estimates place the total value of the North American thermal insulation market at around US$8.5 Billion in 2008 (source Freedonia). Separate estimates indicate that the market size in the U.S. alone was $7.2 Billion in 2005 (source SBI).

Historical growth rates in demand within the U.S. are estimated at 7% between 2004 and 2005 (the peak of the U.S. housing market). Projections indicate a short term slowing growth rate at 5% CAGR (SBI), creating a U.S. market valued at U.S.$9.5 Billion by 2010 (SBI).

Projections by Reportlinker indicate a 6% rate of demand growth, indicating a US$11 Billion market by 2012. These sources note that tax credits and incentives have helped spur this growth. Data from Owens Corning (which has #1 position in the industry in North America) indicate that five major product groups share this market.

Fibreglass insulation held an estimated 48% of the total market (data probably are 2007 shares) compared with 38% for **rigid foam**, in 2nd position. **Spray foams** accounted for around 9% of the market while **cellulose** (including any industrial hemp insulation sold in North America) accounted for 4% of the total. **Mineral wo**ol held an estimated 1% market share (Exhibit 3).

Focus of This Report – a US$4Billion Sub-Market
Data from the United Soybean Board (www.unitedsoybean.org) indicate that viscous soybean-based polyols are used in a variety of industrial plastics – including spray foam insulation (AGROL 2.8 and 3.0) and rigid molded applications (AGROL 4.0) as a replacement for petro-chemical based products. Rigid and spray-on often compete for market share.

Correspondingly, this report defines the target market for Canola oil and linseed oil polyols as a combination of the North American spray foam and rigid foam markets. As the Exhibit shows, these represented 47% of the estimated thermal insulation market in 2008 – or a 'gross' (i.e. all compounds included) target sub-market of nearly US$4 billion. The prospective bio-based share of this sub-market is estimated at no greater than 10% of the materials portion, benchmarked on the mean bio-based content of linseed oil used by Icynene in its LD-R-50 spray-on insulation product (source: ICC Evaluation Service) as determined by ASTM D 6866.

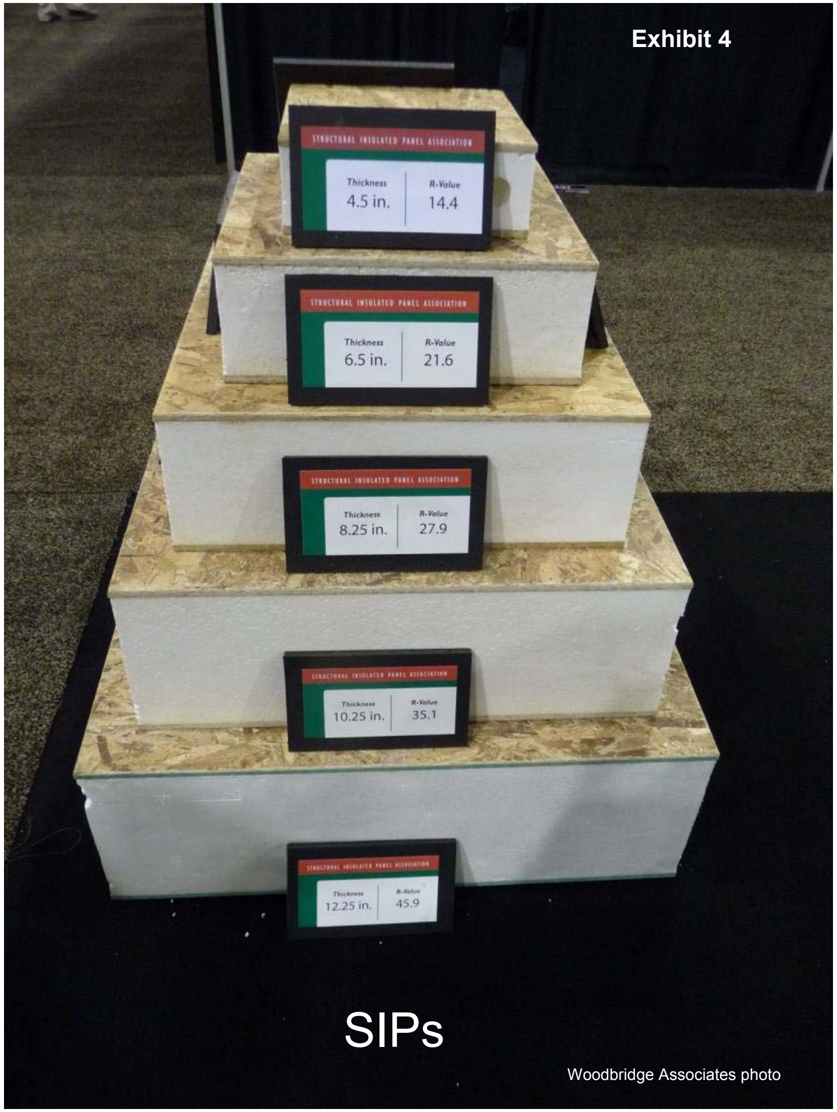
2.2 Foam Product Definitions

2.2 Foam Product Definitions

Rigid Foam

This product sometimes is known as "foam boards" and typically is used to insulate foundations because of its water resistant qualities. Foam boards also are suited for exterior insulation on single walls, under siding and also for roof insulation. They include SIPs (structural insulated panels) which are surfaced with plywood or oriented strandboard (OSB) – Exhibit 4.

Foam boards usually are made up of either expanded polystyrene, extruded polystyrene or polisocyanurate. While polisocyanurate has the best insulation properties, this type of rigid foam and also extruded polystyrene are more harmful to the environment and are said to have an adverse affect on the ozone layer. This is why expanded polystyrene is the most popular choice of rigid foam when creating an environmentally friendly home. Expanded polystyrene rigid foam is a great heat barrier as long as the air pockets remain dry. This rigid foam is best used with a foil of plastic facing (Exhibit 5) to make it a much more water tight home insulation type. Source: http://www.home-improvement-and-financing.com/home-insulation-type.html



2.2 Foam Product Definitions

Liquid or Spray Foam is sprayed in a thin layer onto walls (Exhibit 6) and is left to expand to completely fill the cavity before interior paneling is put in place. The formulation is combined in a static mix tube (Exhibit 7) which combines the 'A' side and 'B' side contents and is applied with an applicator gun (Exhibit 8)

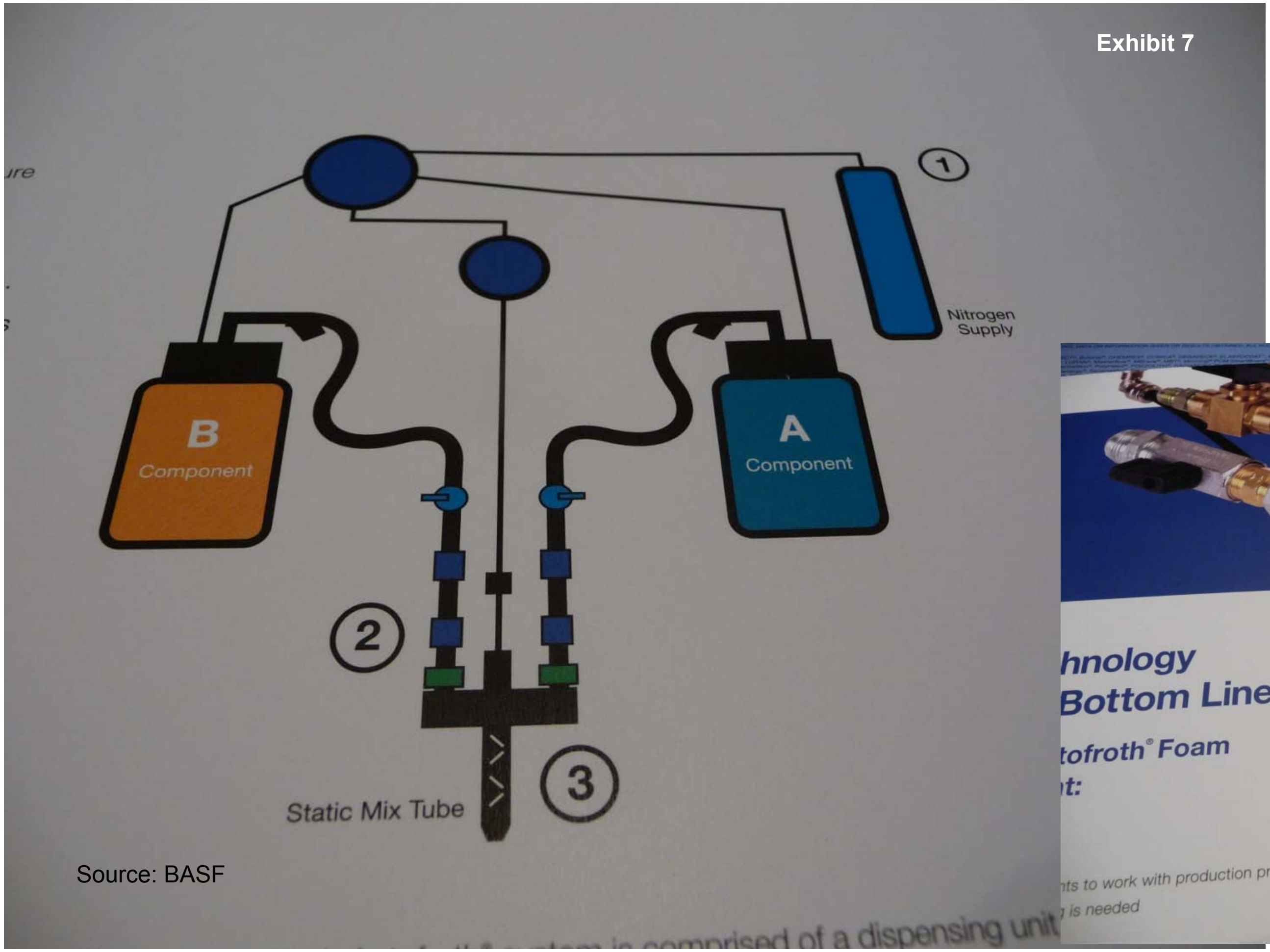


Exhibit 7

Source: BASF

Exhibit 6

Exhibit 8

Source: BASF

2.2 Foam Product Definitions

Spray Foam: Application and Equipment

Both ½ lb (0.2 kg) and 2 lb (0.9 kg) SPF are made from blended systems of polyol resins, catalysts, surfactants, fire retardants and blowing agents on the B-side along with polymeric MDI (methylene diphenyl diisocyanate) on the A-side. These are blended on application and expand to either 35-50 times (2lb) or about 150 times (½ lb) their original volume to form a rigid, or semi-rigid, non structural plastic insulation and barrier. Typical spray equipment is as shown in Exhibit 9 (photo courtesy of Graco Inc.) and requires application by skilled technicians wearing protective clothing (Exhibits 10 and 11). The 'green building materials' content of the SPF makes no difference in this safety respect.

Exhibit 10

Exhibit 11

Exhibit 9

Spray Equipment – The Present

Source: Graco Inc.
Presented at SPFA 2009 Foam Conference

2.2 Foam Product Definitions

Spray Foam Types

Spray foams are produced in several types, and with a variety of formulations. Two principal types are closed cell foams (Exhibits 12 and 13) and open cell foams. The following is quoted from EnviroFoam's website (http://www.envirofoaminsulation.com/versus.html). EnviroFoam is a producer of closed cell spray foam.

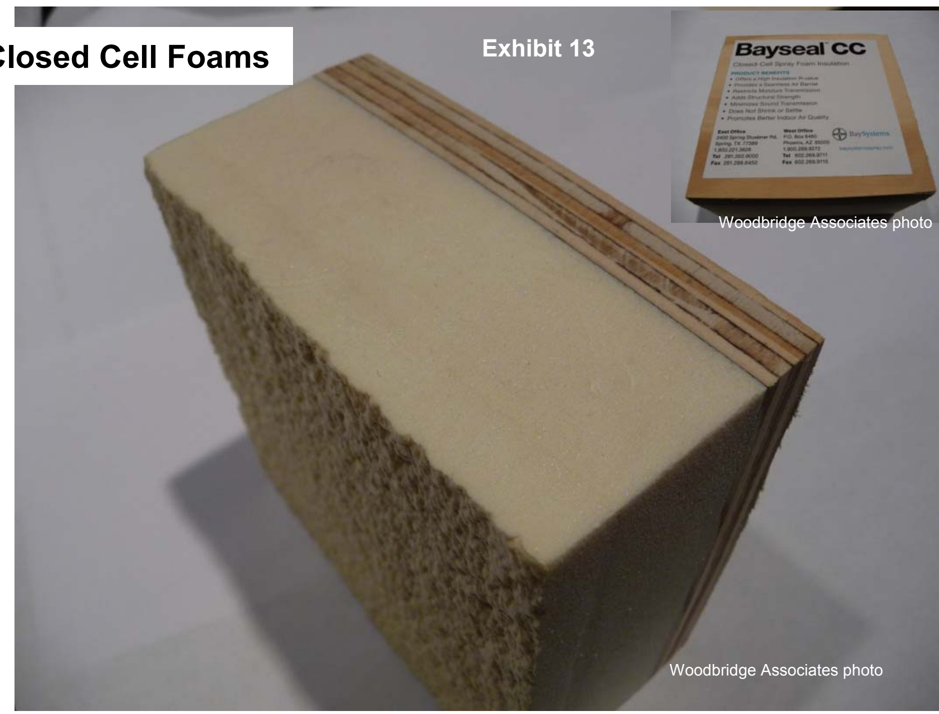
"**Closed cell spray foam** is also referred to as 2 pound or medium density. This foam expands 20 to 30 times its liquid size, and seldom requires trimming with little to no waste. Closed cell foam cures rigid and the millions of microscopic bubbles which form during the expansion reaction remain closed and intact. This traps the reaction gases, and as such the R-Value of closed cell foam is close to that of the reaction gas, around 7 per inch. The closed cell structure is very strong; increasing shear and racking strength by 300%. Closed cell foam is a code approved vapour barrier with a permeability rating of under 45 ng, as well as a code approved air barrier and thermal insulation. Closed cell foam is spray applied as a liquid to create an air-tight seal as it expands as a foam to stop air leakage.

Dense, Closed Cell Foams

Exhibit 12

Woodbridge Associates photo

Exhibit 13



Woodbridge Associates photo

Woodbridge Associates photo

2.2 Foam Product Definitions

Open cell spray foam is also referred to as ½ pound or low density. EnviroFoam notes that "this foam expands to over 120 times its liquid size, and requires trimming and disposal of the waste. Open cell foam (Exhibits 14 and 15) cures soft and the irregular bubbles which form during the expansion reaction are broken or open. These cells or pockets fill with air, and, as such, the R-Value of open cell foam is close to that of dormant air, around 3.6 per inch.

"The R-Value of open cell foam is close to that of conventional fiberglass and cellulose insulation because they all use the same principle of trapping dormant air. However open cell foam is more effective than conventional insulation because it is spray applied as a liquid which conforms to fit the wall cavity. Like conventional insulation open cell foam only slows down convection through and within the wall cavity. Open cell foam is not a code approved vapour barrier with a permeability rating of over 400 ng (source: EnviroFoam).

Icynene is an example of an open cell spray foam.

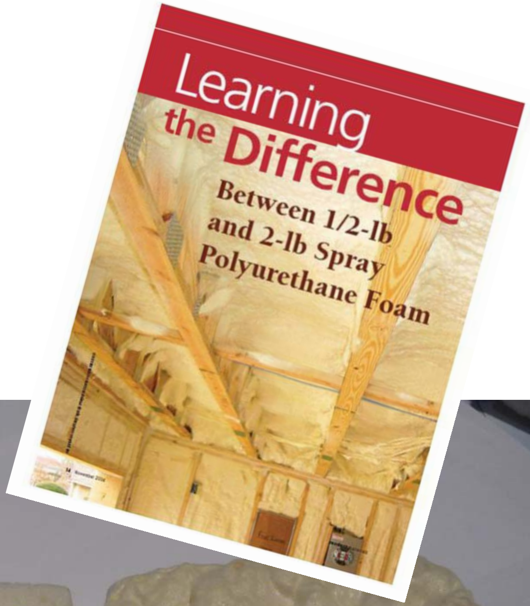



Exhibit 14

Woodbridge Associates photo

Exhibit 15

Woodbridge Associates photo

2.3 Drivers of Demand for Natural Oil Polyol SPFs

2.3 Drivers of Demand for Natural Oil Polyol SPFs

Exhibit 16

The Target Products: Context

SPF foams using Canola oil or flax oil compete for market share within the overall thermal insulation market in North America. As such, they are benefiting from growth in two main drivers:

(1)Overall growth in demand for thermal insulation, and
(2)The shift towards more eco-friendly building products.

Thermal Insulation Market Growth

As already noted, this was an estimated US$8.5 billion market in 2008 growing at a trend level of 5% to 6% per year. But in the view of many analysts', this does not take into account the much faster potential growth that is possible if the factors underlying the shift to green building gain further momentum, as expected.

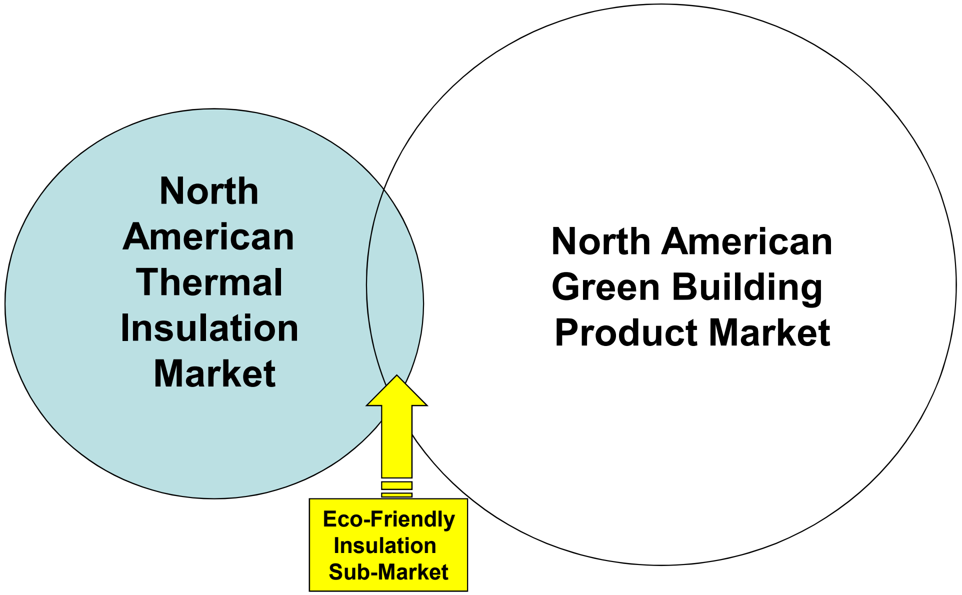
These factors include very high global and regional energy prices, along with shifts in policies and regulations designed to limit the creation and emission of green house gases.

The relationship between the two main drivers is illustrated in Exhibit 16.

North America's thermal insulation market has its own drivers – related to factors such as levels of construction spending (see next page). The green building market drivers are much more complex, and more difficult to evaluate at the present time –in terms of magnitude of impact.

The overall very positive market characteristic for eco-friendly insulation is that, on a long term trend basis, both sets of drivers point to (a) increased per capita consumption levels of thermal insulation – in all types of buildings and (b) the consumer and regulatory shift in favour of eco-friendly products. The remainder of this section looks, firstly, at the drivers of thermal insulation demand and trends in product preferences and, secondly, drivers of the green building market and how these are expected to affect the demand for eco-friendly insulation products, specifically natural -oil -containing SPFs.

Canola Oil and Flax Oil Spray-On Foam (SPF) Insulation is a Niche Market Product … Part of the Eco-Friendly Sub-Market



Encouragingly, Rapid Expansion of the Green Building Products Market is Driving Demand for Eco-Friendly Thermal Insulation Products

2.3.1

Market Trends and Demand Outlook for Thermal Insulation

2.3.1 Market Trends and Outlook for Thermal Insulation

The Overall Market - Demand Drivers.
Several factors determine the overall market trends and outlook for thermal insulation in North America. They include:

- Construction spending levels, and types of structures being built
- Insulation standards
- Government financial incentive programs
- The effectiveness of these programs

These factors are reviewed in the next several pages.

Demand for Different Types of Insulation Products
Once the decision has been made regarding the level of thermal insulation to be applied, the specifier (in new buildings) and the homeowner face a number of choices with regard to the type of insulation to be installed. As already noted, thermal insulation is only one of several causes of building heat loss or incursion. Air tightness and others also are important.

Thus, in the single family and some multi-family residential market, buyers will look at a number of factors including efficiency, convenience, air barriers values and will be influenced by building codes. In this report, one of the issues addressed is the extent to which homebuilders 'voluntarily' will try to persuade

In some single-family housing markets (e.g. Okotoks, AB) and in most non-residential markets, local codes and/or professional specifiers will tend to have more influence in defining the optimum type of thermal insulation and related issues for the building structure .

In this section, we examine these influences under the following headings:

- Construction spending levels
- Insulation standards
- Market drivers affecting insulation standards
- The new housing market
- The home improvement/DIY market
- Financial incentive programs
- Non-residential markets

Construction Spending Levels

The overall level of construction spending in North America is the most important determinant of the demand for thermal insulation. Construction spending determines how many structures are built – and related characteristics such as what type and size of building. Of course, construction spending also includes public money spent on roads and infrastructure but, as shown in the exhibits below, private sector spending predominantly on residential and non-residential structures accounts for the bulk of overall construction spending in both Canada and the United States. The US overall market size is almost ten times that of Canada.

Exhibit 17 shows the trend in US construction spending from the start of the recent housing boom in 1993 to its most recent peak in 2006. Overall construction spending more than doubled over this period to a peak of US$1.2 Trillion by 2006. With the collapse of the US housing market, private residential spending has capsized -and, in May 2009, overall construction spending is running at a level of around US$850 Billion annually.

Canada's construction spending (Exhibit 18) which peaked later than in the US (in 2007, with particular strength in Alberta, related to Oil Sands spending continuing into 2008), also has declined . Currently it is running at a lower annualized level than in 2008 and is expected to show a year-over-year decline for 2009.

Exhibit 17

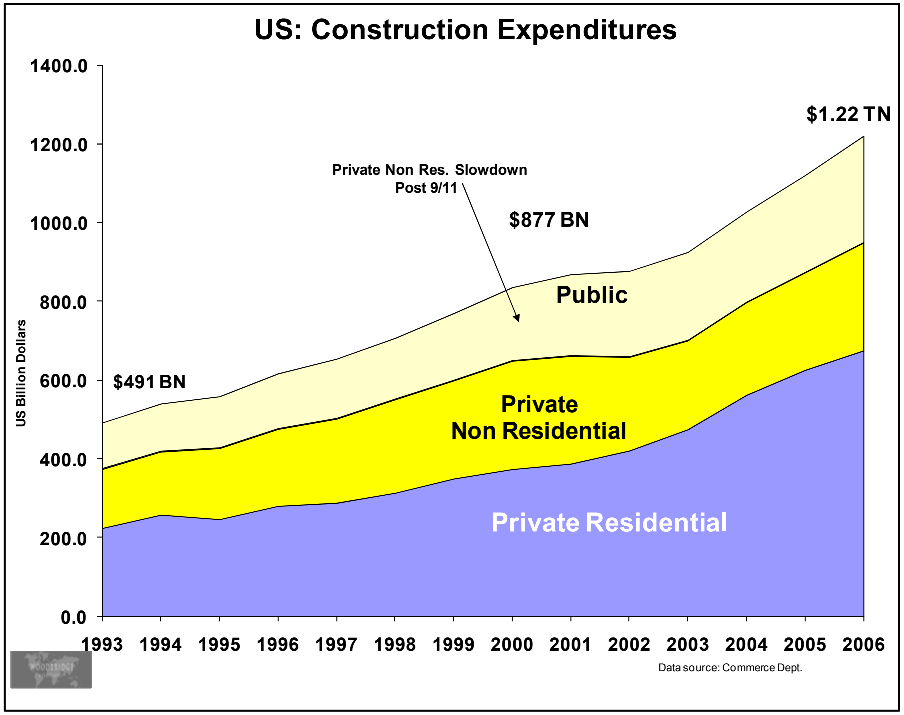
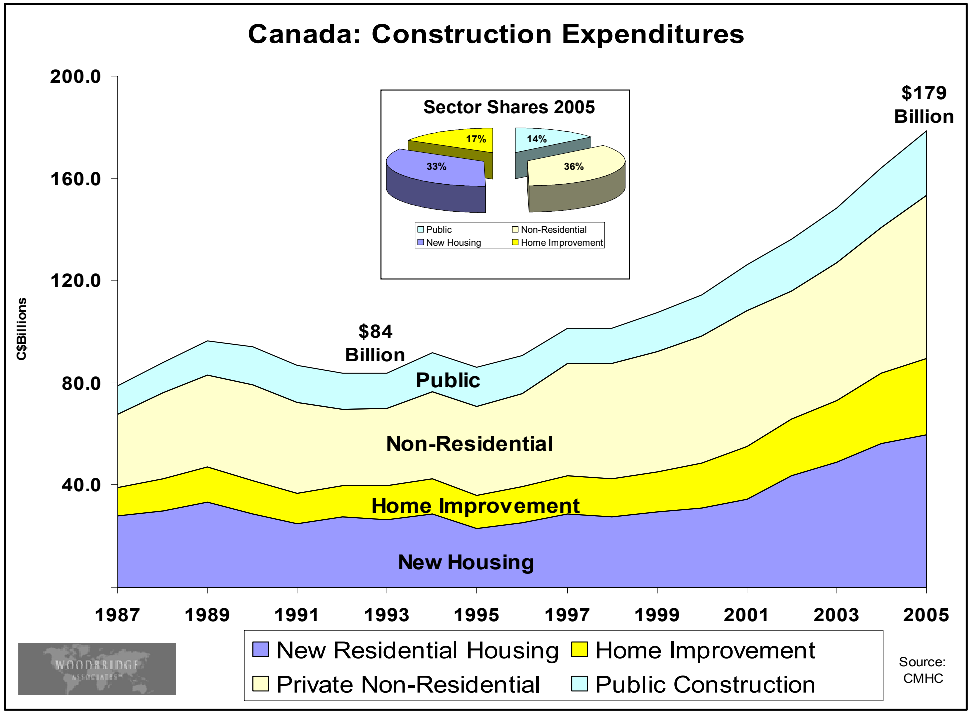


Exhibit 18



Insulation Standards

Drivers of Demand: Energy Efficiency Standards in North America

With high and rising fuel costs, it is clear that energy issues are of concern to most homeowners and renters. Over many years, building codes have evolved and have established increasingly high standards for energy efficiency in homes. Insulation materials have improved immensely.

There are efforts underway to introduce uniform building codes in North America, and in construction worldwide (see www.iccsafe.org and www.naffainc.com). Currently, a range of model codes is in existence, and local codes vary to meet specific needs (e.g. high seismic risk or high snow load areas).

With regard to energy consumption in single family homes in Canada, Exhibit 19 shows that R2000 homes are significantly more energy efficient than housing constructed under earlier codes. Further improvements have been achieved with advanced energy efficiency homes – ultimately aimed at **net zero energy homes**.

The Exhibit shows that there have been only minor reductions in energy needs for hot water and electricity in the existing housing stock in Canada. But over the years there have been major improvements in space heating efficiencies – using low cost technologies. From around 128 GJ/y required by typical homes in 1975, energy needs for space heating has declined to approximately 35 GJ/y for R2000 homes.

Alberta Research Council (ARC) data show that, for Edmonton AB, typical levels of energy use for space heating purposes declined significantly after WWII, and again after the mid-1980s. Much of this can be attributed to more demanding building code standards – and rising concerns over energy costs.

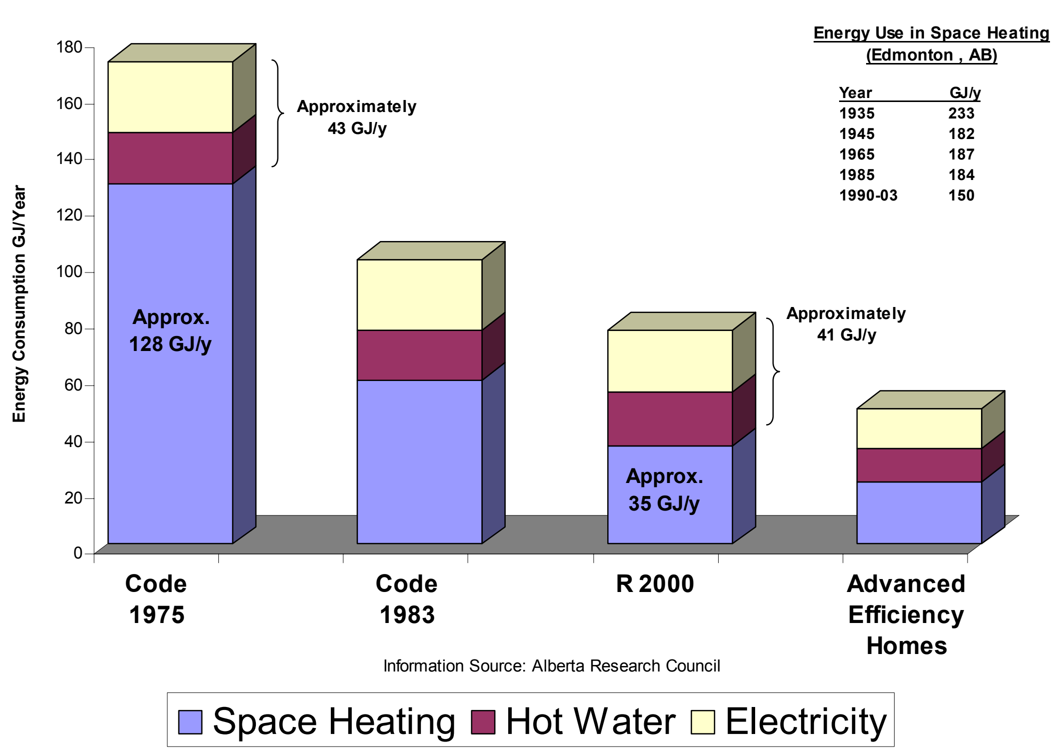
With continuation of very high energy prices throughout the world, energy efficient new construction (along with concerns over GHGs) have become a matter of public policy. Historically, North America has been slower to adopt these higher standards –but this is now changing rapidly.

Conventional, low cost, technologies (such as fibreglass insulation, weatherproofing and proper caulking) have contributed substantially to energy efficiency in the home. Alternative 'green' building products have to offer significant additional benefits in order to attract consumers' attention.

These benefits could include GHG savings; the use of more environmentally friendly materials (such as natural fibres, including hemp); health benefits and ease-of-installation. But some of these are soft factors in the minds of consumers … and price counts in the buying decision!

Annual Energy Consumption in Canada
Single Family Homes

Exhibit 19



Information Source: Alberta Research Council

Market Drivers: Rising Standards of Insulation

Insulation and Air Leakage: Close Cousins

Effective insulation, and the elimination of uncontrolled air leakages, are 'close cousins' in the sense that even the best standards of insulation can be rendered ineffective if unwanted air leakages occur in the building envelope and its interface with the exterior environment. This factor accounts for a significant part of the growth of spray-foam insulation. As noted earlier, hard and soft foams account for 47% of the total market for thermal insulation in North America – and their popularity is growing.

Spray-foams (Exhibit 20) offer the advantage of creating an air-seal, which traditional insulation 'batts' installation finds it difficult to match. One of the many consumer (and builder) complaints about fibre-glass insulation batts is that over time they can sag and become less effective, or sometimes completely ineffective. But air gaps also can occur with spray-on foams – where, for example, lumber shrinks (Exhibit 21).

Thermal bridging is created when materials that are poor insulators come in contact, allowing heat to flow through the path created. Insulation around a bridge is of little help in preventing heat loss or gain due to thermal bridging. The bridging has to be eliminated, rebuilt with a reduced cross-section or with materials that have better insulating properties, or with an additional insulating component (Wikipedia).

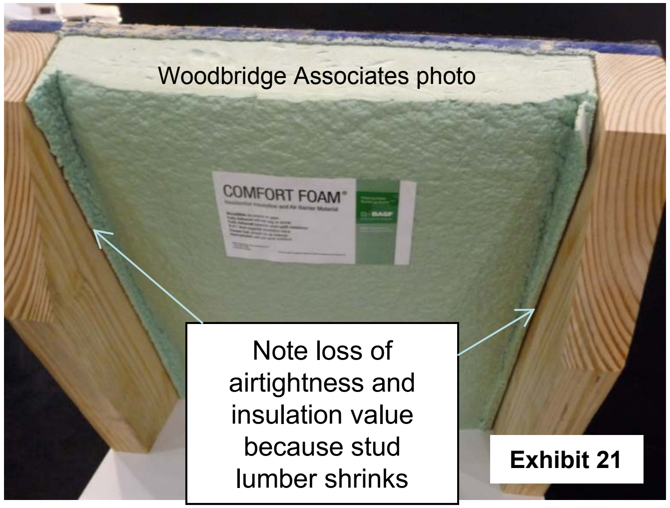


Exhibit 21

Exhibit 20

The New Housing Market

How Much is Spent in New Homes on Insulation?

Homebuilders are acutely aware that, traditionally, the North American *new residential housing* market has been very sensitive to insulation costs. Attitudes in Europe and other regions exposed to high purchased energy costs are more concerned about these issues, and insulation standards during construction are generally higher.

Although this situation is evolving rapidly in North America, overall, it appears that most homeowners today still have a fairly low threshold for investing in energy saving technologies – even in the face of relatively high home energy costs. Few consumers appear willing, as yet, to contribute directly towards a reduction in societal costs.

As a result, the insulation industry is very sensitive to the willingness of homeowners to pay for energy efficiency in new residential homes (see text box below). The industry is cautious about advising consumers to 'over-insulate'. Traditionally, only 2% of the typical cost of a new home is insulation (Exhibit 22), although a whole building approach to insulation, air-tightness and moisture control, also would also take into account windows, doors and building structure.

This, we believe, reinforces the business case need for prospective manufacturers of SPF insulation to achieve a very cost competitive product – and win market share by offering a better product than existing insulation types.

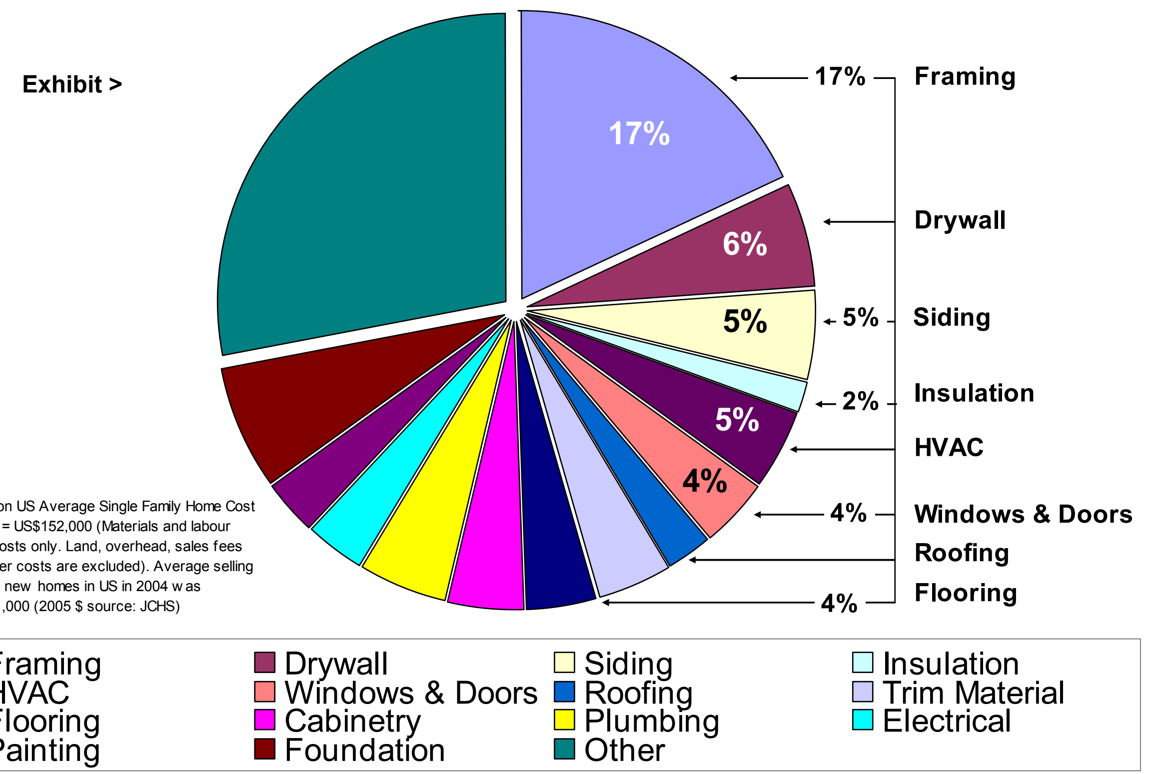
To keep initial selling prices competitive, many home builders offer the legal minimum (not optimal) levels of insulation. (NAIMA)

"The amount of insulation you need depends mainly on the climate you live in. Also, your fuel savings from insulation will depend upon the climate, the type and size of your house, the amount of insulation already in your house, and your fuel use patterns and family size. If you buy too much insulation, it will cost you more than what you'll save on fuel"

(from US Insulation Industry Website)

Housing: Typical Cost Components **Exhibit 22**

Green Building Technologies Potentially Could Influence 32% of Materials & Labour



Based on US Average Single Family Home Cost in 2004 = US$152,000 (Materials and labour direct costs only. Land, overhead, sales fees and other costs are excluded). Average selling price of new homes in US in 2004 was US$231,000 (2005 $ source: JCHS)

Data source: Bain & Co. Presentation to BMHC Board of Directors Sept 2004

New Housing: Residential Demand for Thermal Insulation

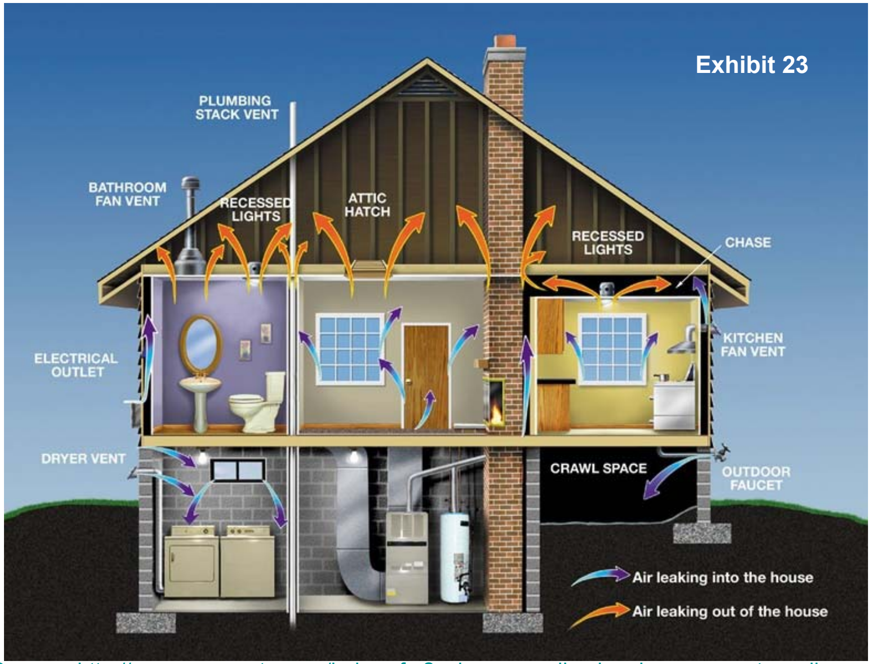
Whole Building System Solutions: Multiple Insulation Types

Air infiltration (Exhibit 23) has a major impact on the real world R-Value that insulation delivers and, as a result, on the thermal performance of an insulated building. Infiltration of unconditioned ambient air means that heating and cooling systems must work harder to compensate for heat losses (in the winter) and heat gains (in the summer).[source: CIMA]. Spending on energy efficiency in residential housing far outpaces spending on air quality and soundproofing (Exhibit 24).

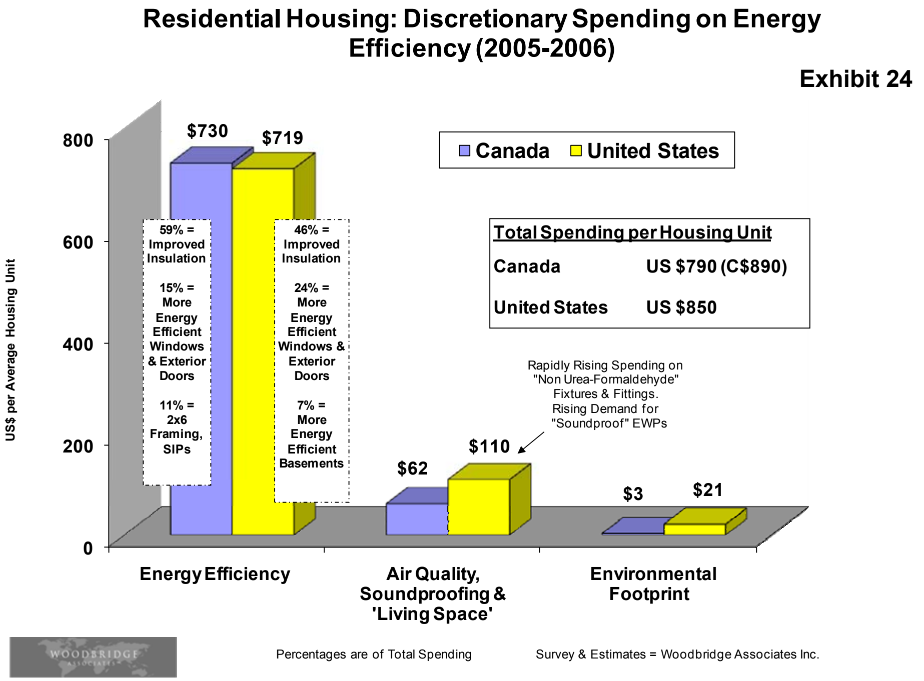
Increasingly, rather than looking at traditional faults such as heat loss/gain; air infiltration and moisture control as separate problems, requiring separate solutions, whole building system approaches tackle them as a single issue – which can be addressed and optimized using multi-product solutions.

Key related issues are sustainable building designs and zero carbon footprint. LEED already has established itself in this regard – with the result that LEED certification for commercial and industrial buildings, and LEED or NAHB certification ('energy efficiency sticker) for residential housing, may become part of the building's re-sale value.

Building codes in the United States and Canadian building code regulators are still a long way from developing such requirements. Since October 2008, however, the British government has required anyone selling or renting a home to obtain an energy performance certificate that rates the dwelling on an A-to-G scale for efficiency. (source Roxul). SPF insulation could also become part of a wholistic integrated solution.



Source: http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing



Home Improvement Demand for Thermal Insulation

The Home Improvement Market

The home improvement market represents an important **retrofit market** for SPF insulation –notably in hard-to-access walls and air pockets around rough openings.

North America (like Europe) has a huge housing stock that is below modern code standards in a variety of respects. The total housing stock in the US alone was over 126 million units in 2007.

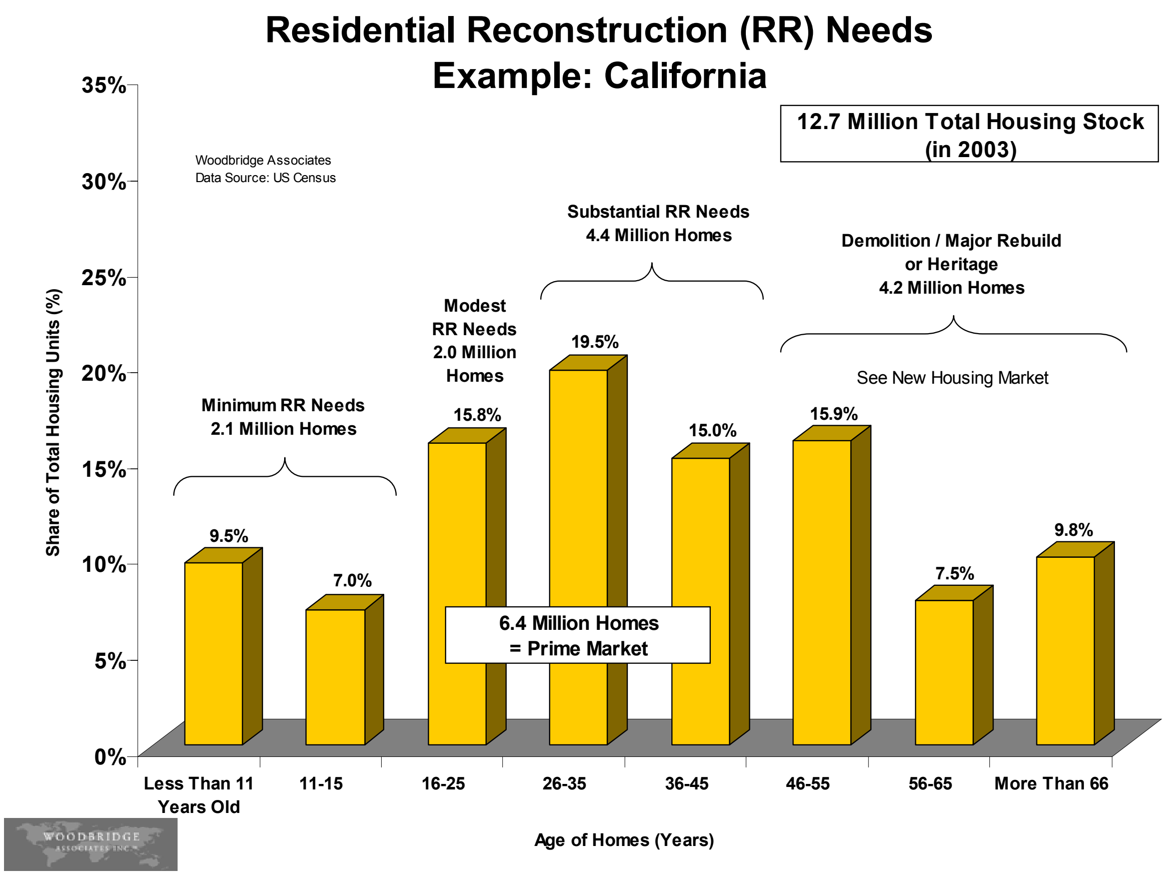
Depending on the state or region, many of these are older homes. A large proportion fall below current code levels for energy efficiency. Proportionally, similar conclusions can be made about the housing stock in Canada. Exhibit 25 presents an example of our projections of residential reconstruction needs in the US (a potential export market for Alberta). In 2003 (most recent Census data), California for example had a total housing stock of 12.7 million units, housing a total population in excess of 35 million persons.

We estimate that around 17% of California's housing stock is of recent vintage and in most instances meets, or is close to, current code standards. A further 16% has very modest needs in terms of up-gradings. Typically, home improvements for these groups of homes involve upgrading of kitchens (new appliances), cabinets, bathrooms, flooring, the installation of new windows, new mouldings and generally investments in higher grade living conditions.

But nearly 35% of California's homes require substantial improvements –including structural and often substantial investments in energy efficiency. Similar analyses can be carried out for most markets.

For market size assessment purposes, these data provide a broad indication of the maximum scale of the potential retrofit market. For the US overall, *conceptually*, this total market probably is in excess of 70 million existing homes currently. In Canada, it could be around 7.5 million existing homes.

Exhibit 25



Insulation: Financial Incentives Programs

In order to make a meaningful energy policy impact by providing financial incentives for thermal efficiency programs, governments take into account both the existing housing stock and new housing. Some older homes are so energy inefficient that they do not justify retrofitting, while others within the existing housing stock range from being poor to very good candidates for various types of energy-use improvements. Clearly, it is difficult to devise and implement programs that adequately cater for this wide spectrum of needs. In addition, the homeowner also is required to pay a significant part of the cost of upgrading --and will receive compensation through lower operating costs and/or potentially higher selling prices. But the benefits and costs are not always clear. In addition, there are differences in policy objectives between the US and Canada (Exhibit 27).

Currently, federal and state/provincial governments in Canada provide a range of grants and financial incentives (e.g. Exhibit 26 for the US). Various quasi-government agencies and energy utilities also have comprehensive programs that have the objective of upgrading the existing housing stock. Building codes govern the quality of energy efficiency in new housing.

"Various tax credits for energy-efficient products, like Energy Star-rated windows, and a growing number of state and local incentives for buying green are also encouraging consumers to choose energy- and resource-efficient products and homes" source: NAHB.

Canada: http://oee.nrcan.gc.ca/residential/personal/retrofit-homes/retrofit-qualify-grant.cfm?attr=4#important-notes

Exhibit 26

Climate Change & Energy Saving

Thermal Efficiency in U.S. Residential Housing

Upgrading: Financial Incentives

U.S. home builders are eligible for a $2000 tax credit for a new energy efficient home that achieves 50% energy savings for heating and cooling over the 2004 International Energy Conservation Code (IECC) and supplements.

At least 20% of the energy savings must come from building envelope improvements, like insulation (source: Icynene).

U.S. home owners, can claim 30 percent of the cost of qualified energy efficiency products, up to $1,500, including insulation, windows and doors, roofs, HVAC equipment, and water heaters.

Many states and local utilities offer energy efficiency rebates for certain home improvement-related purchases.

Exhibit 27

Canada: Insulation, Home Sealing Products and ENERGY STAR®

Insulation and home sealing products are NOT included in Canada's ENERGY STAR program. Natural Resources Canada (NRCan) works closely with the U.S Environmental Protection Agency (EPA) to harmonize product specifications and promote consistency between the ENERGY STAR programs in Canada and the United States. Nevertheless, differences in program approaches do exist, occasionally resulting in differences between the types of products and activities supported by the program in the two countries. In Canada, the ENERGY STAR Program is focusing strictly on a product-based qualification system only.

With respect to insulation, the position of Canada's ENERGY STAR program is that installed R-values are more important than the rating on the products themselves. The effectiveness of insulation depends on the quantity installed and the quality of the installation as a product. With respect to material quality Canada benefits from the material evaluation services provided by the Canadian Construction Materials Center Insulation and air sealing initiatives are being promoted through Canada's ecoENERGY Retrofit program, and grants are provided based on the range of insulation levels achieved, as verified by an ecoENERGY retrofit adviser through a pre and post retrofit home evaluation. Eligible improvements and levels of grants can be found on the NRcan Web site.

Source: http://oee.nrcan.gc.ca/residential/business/manufacturers/insulation.cfm?attr=4

Insulation: Financial Incentives Programs

Program Effectiveness

During the current global and North American economic recession, which is accompanied by comparatively high global energy prices, considerable interest is being shown by insulation manufacturers and many others regarding consumers' attitudes to elective expenditures on thermal insulation. Linked to this, are financial incentive programs and their effectiveness in bringing about desired public policy changes. Key issues include the willingness to specify and pay for higher standards of insulation.

A recent survey (Exhibit 28) by leading insulation manufacturer Johns Mansville showed that, of the 46% of U.S. homeowners who were aware of the federal energy efficiency tax credit, only 13% planned insulation projects. To bring about a paradigm shift, the two policy choices are voluntary and regulated (Exhibit 29).

Drivers of Demand for Thermal Insulation in Housing Markets

Key Issues

… willingness to specify,
….willingness (and ability) to pay,
+ gov't stimulus packages

Exhibit 28

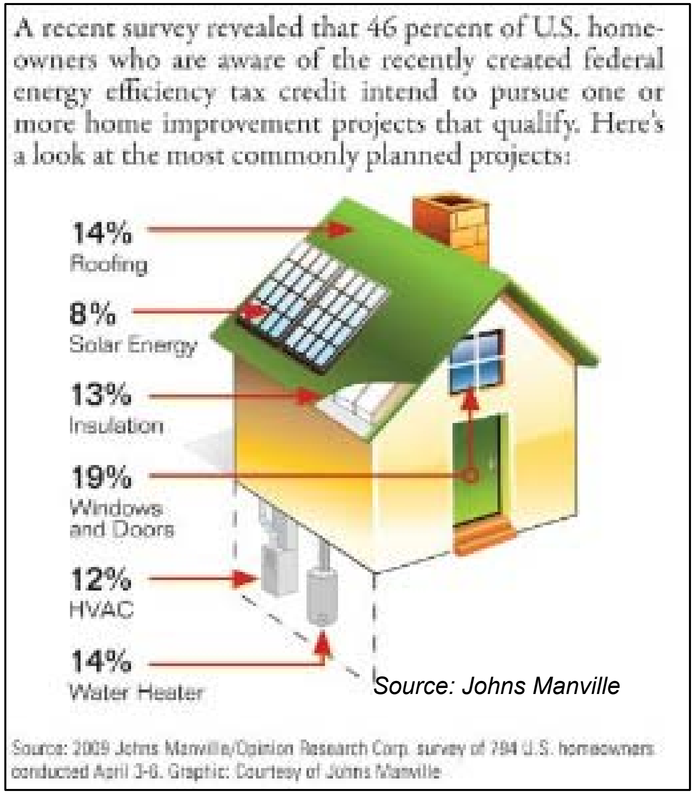


Exhibit 29

Shift to NOPs in SPF Thermal Insulation: Paradigm Shift?

There are Only Two Policy Choices!

Voluntary → **Regulated?**

Gov't Incentive Programs
for Higher Insulation Standards (All Thermal Insulation Types)

Market and Specific Public Policy Incentives for Non-GHG Thermal Insulation Products

Non Residential Markets for Thermal Insulation

Non-Residential Markets

As a potential market for green building products, the private non-residential construction sector in North America offers a substantial number of different characteristics – which, we believe, can assist in their early introduction. The non-residential market (Exhibits 30 and 31) is a more diverse sector than the residential market. One vital difference is that most government and commercial structures, such as retail outlets and warehouses, do not compete for the buyers' or leaseholders' attention based on the same criteria used by housing market buyers. Specifically, apart from location, "street appeal" of the structure is a high priority for homebuyers. It is far less important for buyers and owners of non-residential structures.

Another significant difference is that owners and leaseholders of retail, hospitality and commercial buildings that are frequented by consumers (e.g. shoppers) are generally quite sensitive to 'green issues'. In particular, as membership in the LEED program demonstrates, the majority of decision makers involved in building design in this sector generally are acutely sensitive to issues such as energy efficiency. "Approval" by consumers (e.g. shoppers) of commercial operators whose buildings are built-green is very strong –and is far ahead of the equivalent types of consumer ratings linked to most homebuilders (although there are some notable exceptions of leading edge built-green homebuilders and high acceptance by some groups of homebuyers).

Thirdly, the diversity of shapes, sizes, designs and functional types in non-residential construction provide an opportunity for architects, designers, specifiers and building inspectors to explore the commercial potential of advanced energy efficient structural technologies, and green building products. Additionally, non-residential structures offer scale. Compared with single family housing units, which average 2,400 square feet in North America, non-residential structures (generally 10,000 to 200,000 square feet per unit) offer a larger footprint for commercial testing of energy efficient technologies.

Exhibit 30

Exhibit 31

Non Residential Construction Markets

Private Sector
- Retail
- Offices
- Commercial and Institutional Buildings
- Light Industrial Structures, including Storage
- Large Industrial Structures
- Agricultural and Other Structures

Public Sector and Military
- Schools & Education
- Government and Public Buildings
- Airports and Transportation
- Other Structures

Photo: Woodbridge Ass

2.3.2
Green Markets:
The Shift Towards more Eco-Friendly Building Products.

Insulation Standards

North American Demand for Low GHG Emitting, and Green-Building Products

Governments internationally, regulators and consumers are concerned increasingly about 'planet issues' and 'pocketbook issues' (Exhibit 32). This is a relatively recent dual phenomenon. In terms of household thermal insulation, for example, most North American homeowners have been quite ambivalent until recently about the need for higher residential standards. Historically, they have had few sustained concerns about rising space heating prices – or global energy prices (Exhibit 33). In addition, until recently most North Americans paid scant heed to concerns about airborne particulates that might emerge from products such as fibreglass insulation and duct covers.

Today, concerns about global warming and the need to reduce greenhouse gas (GHG) emissions have raised the prospect in North America of a carbon pricing mechanism – most likely involving a 'cap and trade' system of carbons credits. In recent years too, consumers and businesses have been hit by rapidly rising purchased fuel costs. There now appears to a shift from purely voluntary action on many of these issues to a regulated approach. Moreover, consumer values are evolving rapidly in the direction of net zero impacts (e.g. net zero energy housing) and an emerging willingness among some to pay a price premium for energy efficient and low or zero GHG products. Importantly, manufacturers and the construction industry are shifting the raw materials they use, and the products they design, build and/or manufacture, to comply with these trends.

Exhibit 32

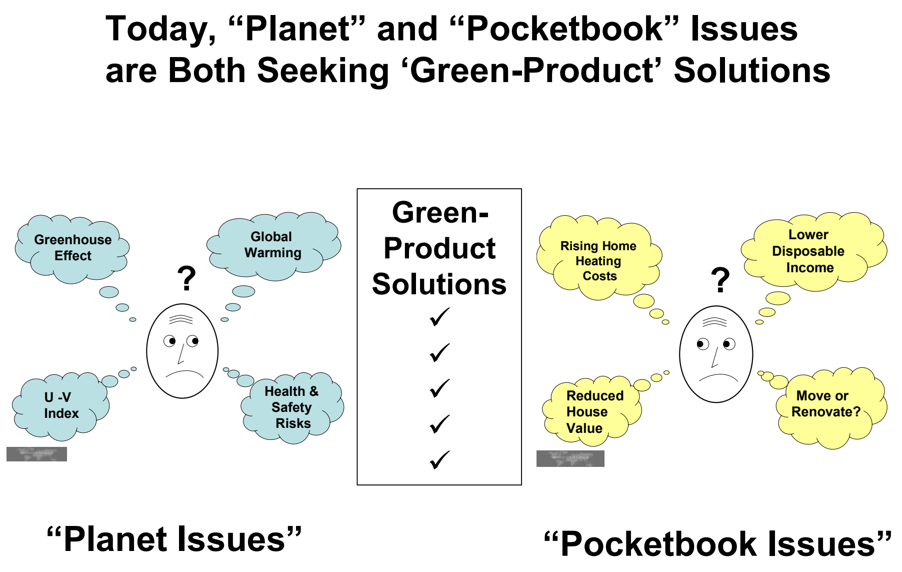
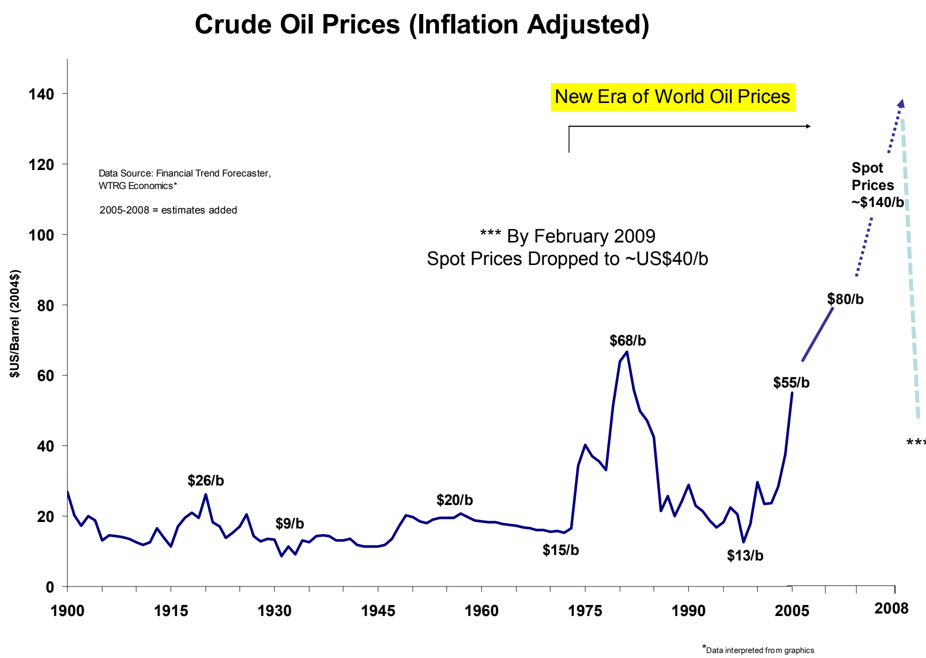


Exhibit 33



Emerging Markets for Earth-Friendly Building Products

North American Market Size – Overview

Definitions of 'green building materials' vary widely, and estimates of the market size in North America have been revised several times – often with definitional changes. The definition used in this report focuses on all construction materials. In 2006, McGraw Hill estimated the total size of the market in 2005/06 was US$ 5.7 Billion (Exhibit 34). By 2007, McGraw Hill had revised its earlier estimates and forecast an even faster rate of growth in demand – to US$40-50 Billion by 2010. This estimate was made towards the end of the residential building boom. The most current estimate by McGraw Hill (in 2009) predicts market size between US$96-140 Billion by 2013 (Exhibit 35).

It is worthwhile noting, in terms of actual consumption at the peak of the market that private non-residential construction accounted for an estimated 40% of the total market, and the public sector a further 37%. Canada had a disproportionately large share (compared with its population) of the private non-residential market – reflecting the strength of Canada's resource construction projects (e.g. oil and gas, mining) and construction of industrial, commercial and office buildings at that time. Residential housing (including home improvement) comprised 23% of the total market – and 94% of this was in the United States. In our view, the current data for 2009 do not properly reflect longer term market trends, principally because of the lack of construction activity in residential housing at the present time. Thus, we base our forecasts on normalized, not current, market conditions.

Exhibit 34

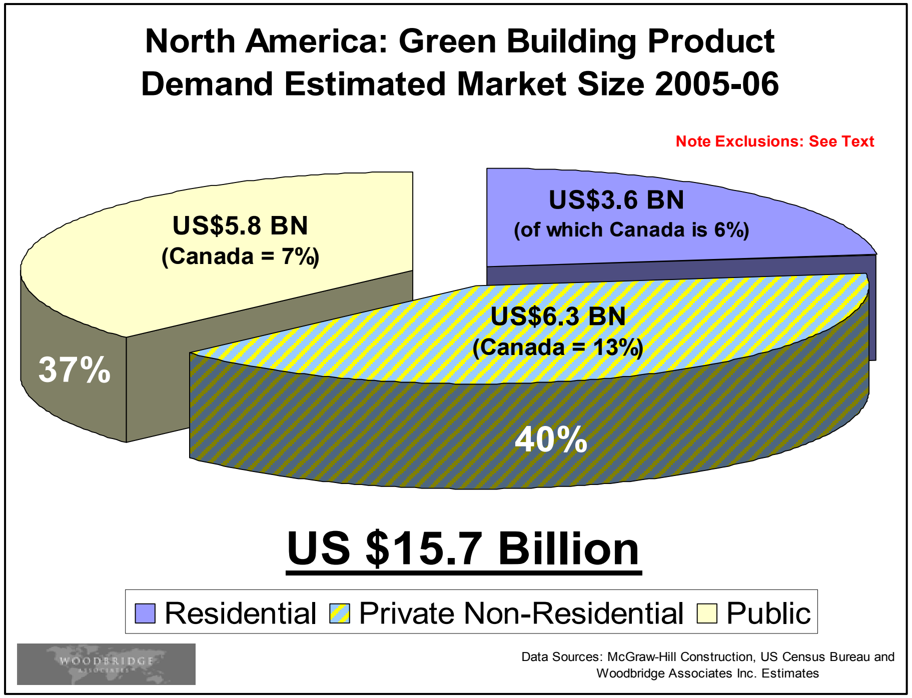


Exhibit 35

Rapid Growth!

2005/06	=	US$ 15.7 BN
2007	=	US$ 40-50 BN by 2010
2007	=	US$ 36-49 BN Actual (2009)
2009	=	US$ 96-140 BN by 2013

Source: McGraw Hill

Most of Growth (But Not All) in Non-Residential Buildings

Drivers of Demand: Environmental Issues

Both ½ lb (0.2 kg) and 2 lb (0.9 kg) SPF are made from blended systems of polyol resins, catalysts, surfactants, fire retardants and **blowing agents** on the B-side along with polymeric MDI (methylene diphenyl diisocyanate) on the A-side(source: SPFA).

Blowing Agent –Definitions:

Several definitions available on the Inet help explain the purpose of blowing agents. Wikipedia defines them *as "a foaming agent is a surfactant, which when present in small amounts, facilitates the formation of a foam, or enhances its colloidal stability"* en.wikipedia.org/wiki/Blowing_agent . Another source defines them as *"an additive that decomposes during the curing process to yield a large volume of gas to create the cells in foamed urethane"* www.mearthane.com/urethane_glossary.html. Another notes that they comprise "*Any substance which alone or in combination with other substances is capable of producing a cellular structure in a plastic. Blowing agents include compressed gases that expand when pressure is released, soluble solids that leave pores when leached out, liquids that develop cells when they change to gases, and chemical agents that decompose or react under the influence of heat to form a gas. Chemical blowing agents range from simple salts such as ammonium or sodium bicarbonate to complex nitrogen [and , formerly, chlorine] releasing agents*". Source: http://composite.about.com/library/glossary/b/bldef-b712.htm (definition copyright 1989 CRC Press LLC).

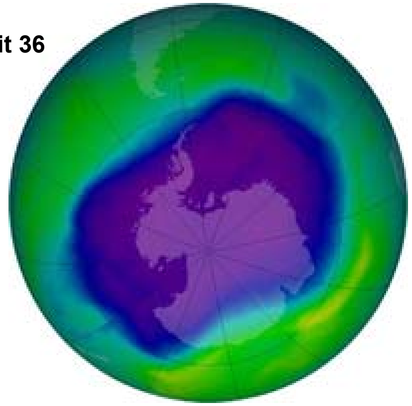
SPF Blowing Agents: 'Zero ODS'

Today, SPF contains no formaldehyde or ozone depleting substances. However, twenty years ago, 2-lb SPF employed CFCs (chlorofluorocarbons) as its blowing agent, but this compound became known for its significant upper-ozone depleting ('ODS') characteristics (Exhibit 36). In the late 1980s, the industry converted to a blowing agent with low ozone-depleting properties, and spray-on foam providers moved to non-ozone depleting blowing agents by the mid-2000s (source: SPFA in Modern Materials Nov 2004) .

As part of the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, the use of HCFC-141b was phased out around the world. HFC-245fa (hydrofluorocarbon-245fa), is Honeywell's current non-ozone depleting blowing agent. The product was designed to replace HCFC-141b (hydrochlorofluorocarbon-141b) in a variety of foam-blowing applications essential to rigid polyure-thane and polyisocyanurate foam insulation, including refrigerator and freezer insulation foam, boardstock foam used in construction for roofing and sheathing, and spray foam used in construction applications (source: Honeywell).

Wikipedia notes that *"It is believed that if the international agreement is adhered to, the ozone layer is expected to recover by 2050. Due to its widespread adoption and implementation it has been hailed as an example of exceptional international co-operation with Kofi Annan quoted as saying that "perhaps the single most successful international agreement to date has been the Montreal Protocol"*

Exhibit 36



The largest Antarctic ozone hole recorded as of September 2006. **Source: Wikipedia**

The reactive blowing agents used today in SPFs are shown in Exhibit 37. The ½ lb foam uses water, while the 2lb foam uses HCFCs or HFCs.

None of these is ozone-depleting (ODS substances) according to their manufacturers and testing agencies.

Exhibit 37

Reactive Blowing Agents Used today in SPFs

SPF Foam-Type	Reactive Blowing Agent
½ lb Open Cell	Water
2lb Closed Cell	HCFCs (hydrochlorofluorocarbons) HCFs (hydrofluorocarbons)

Drivers of Demand: Environmental Issues (continued)

Emerging Markets for Earth-Friendly Building Products

Polyol Resins and Natural Oil Polyols

The ½ lb (0.2 kg) and the 2 lb (0.9 kg) foams also use polyol resins, as part of their blends on the B-side. The production of polyester polyols from vegetable oils is becoming increasingly important. These materials are known as natural oil polyols, or NOPs. Most NOPs qualify as bio-based products, as defined by the United States Secretary of Agriculture in the Farm Security and Rural Investment Act of 2002 (source: Wikipedia). Wikipedia notes that *" the hope is that using renewable resources as feedstocks for chemical processes will reduce the environmental footprint by reducing the demand on non-renewable fossil fuels currently used in the chemical industry and reduce the overall production of carbon dioxide, the most notable greenhouse gas (GHG). One NOP producer, Cargill, estimates that its BiOH(TM)polyol manufacturing process produces 36% less global warming emissions (carbon dioxide), a 61% reduction in non-renewable energy use (burning fossil fuels), and a 23% reduction in the total energy demand, all relative to polyols produced from petrochemicals.*

The name polyols refers to alcohols containing multiple hydroxyl groups. In two technological disciplines polyols have special meaning. They are food science and polymer chemistry (source: Wikipedia). In polymer chemistry, polyols are compounds with multiple hydroxyl functional groups available for organic reactions. The main use of polymeric polyols is as reactants to make other polymers, They can be reacted with isocyanates to make polyurethanes, and this use consumes most polyether polyols. These materials are ultimately used to make foam insulation for appliances , such as refrigerators and freezers, adhesives, automotive seats and so on.

Naturally occurring polyols like castor oil and sucrose can also be used to make synthetic polymeric polyols. These materials are often referred to as the "initiators" for the polymeric polyols, but they should not be confused with free radical "initiators" used to promote other polymerization reactions. The functional group used as the starting point for a polymeric polyol need not be a hydroxyl group; there are a number of important polyols which are built up from amines. A primary amino group ($-NH_2$) often functions as the starting point for two polymeric chains, especially in the case of polyether polyols (Wikipedia).
Several proprietary "green product" and/or "renewable bio-based" SPF foams contain vegetable oil polyester polyols, or NOPs. They include:

Icynene (a ½ lb open cell foam) : ICYNENE LD-R-50 uses linseed oil
EnviroFoam (a 2lb closed cell foam): uses soybean oil
Walltite: uses castor oil

Focus of this Report on Canola Oil and Flax/Linseed Oil

Environmental issues are important drivers of the need for bio-based insulation products, as noted above. Producers of SPF foams, however, have a number of issues to take into account in choosing between the various NOPs that are available, including Canola oil, linseed oil and soybean oil. These issues include the following:

Environmental Issues
- Performance (as noted above)

Economic Issues
- Building codes
- Effectiveness (as part of the SPF blend for insulation, air barrier and water barrier purposes)
- Production costs (including raw material prices for NOPs)

Strategic Raw Materials Supply Issues
-Where are the NOPs made, and are there any potential 'interruptible supply' issues?

Emerging Markets for Earth-Friendly Building Products

Home Buyers' and Homebuilders' Attitudes to Home Energy Costs

One of the assumptions, widely made in green building literature, is that North American homeowners are concerned about their home energy costs. It is also assumed that these concerns stem from both "pocket book and planet" issues. In other words, the assumption is that higher home energy costs will motivate behavioral changes among consumers – that they will either conserve energy by reducing consumption and/or invest in more energy efficient systems in their homes.

As far as most homeowners are concerned, empirical evidence disputes this assumption –at least as far as past behavioral responses are concerned.

JCHS Study of Energy-Related Remodeling

This June 2006 study, by the highly credible Joint Centre for Housing Studies (JCHS) at Harvard University (http://www.jchs.harvard.edu : study NO6-2) examined the extent to which American consumers have responded so far to higher home energy costs by investing in energy efficient retrofit investments. The study concluded that these investments have been made in only a small percentage of cases. In other words, consumers have not in the past responded to higher energy costs by making even very modest investments in low cost solutions, such as higher levels of wall and roof insulation. This suggests that the willingness of most homeowners undertaking renovations does not favor spending on insulation upgrades. Clearly, there is a strong and growing group of home-owners and homebuyers who demand high energy-efficiency standards (and several homebuilders and communities exist in Alberta who are global leading edge players in this regard). But it's not yet a mass-movement in North America –despite recent spikes in energy prices.

The JCHS study observed that, with sustained high levels of home energy costs, this behavior might change. Evaluation of patterns in several European cities, for instance, suggest that this might be the case. The study noted, however, that first phase responses of the small group of consumers who act pro-actively comprise mainly (a) minor lifestyle change (e.g. turning down the thermostat) and/or (b) adding weather-stripping and upgrading insulation levels –notably in previously un-insulated attics.

Homeowners' Attitudes to Green Building Products

Who Decides?

A study prepared by Professional Remodeler magazine in 2002 (www.housingzone.com) titled *'Who Decides…?'* indicates that various decision makers are involved in determining purchase decisions in remodeling. This and other studies indicate that higher insulation levels are not the highest priority for remodeling expenditures –but that most North American homeowners consider remodeling to be a good opportunity for upgrading insulation to building code standards (but not beyond).

Developing a Green Building Culture

As note earlier, there are two main schools of thought, in terms of the construction industry's willingness to shift to 'green building'.

A: The **'mandate-it'** movement led by interest groups who seek voluntary, but potentially mandatory, standards to be imposed by the consumer and specifying authorities – including architects, engineers, government departments, cities, building code specifiers. Support is given by a wide range of groups including those noted, and by change activists. This movement is strong in Europe.

B: The **'voluntary guidelines'** movement led by the NAHB (which has developed its own voluntary guidelines). This is supported by homebuilders and others.

'Mandate-It' Regulations

With the new (Obama) administration in Washington, as of early 2009, it appears that zero carbon targets and energy efficiency in buildings might become the standard for the USA –as they are in many countries within the European Union. If this occurs, as expected, it will help the growth in demand for products such as hemp insulation.

3.1

Bulk, High Volume Producers and DIY Market Manufacturers

3.1 Bulk, High Volume Producers and DIY Market Manufacturers

Two Major Product Groups

Manufacturers aim their products at two markets:

1. Bulk, high volume professional contractor applications market
2. The smaller volume, higher margin DIY market.

The bulk of spray foams (Exhibit 38) used is applied in bulk applications. The process requires combining two sets of chemicals on site (the 'A' side and 'B' side, Exhibits 39 and 40).

Exhibit 38

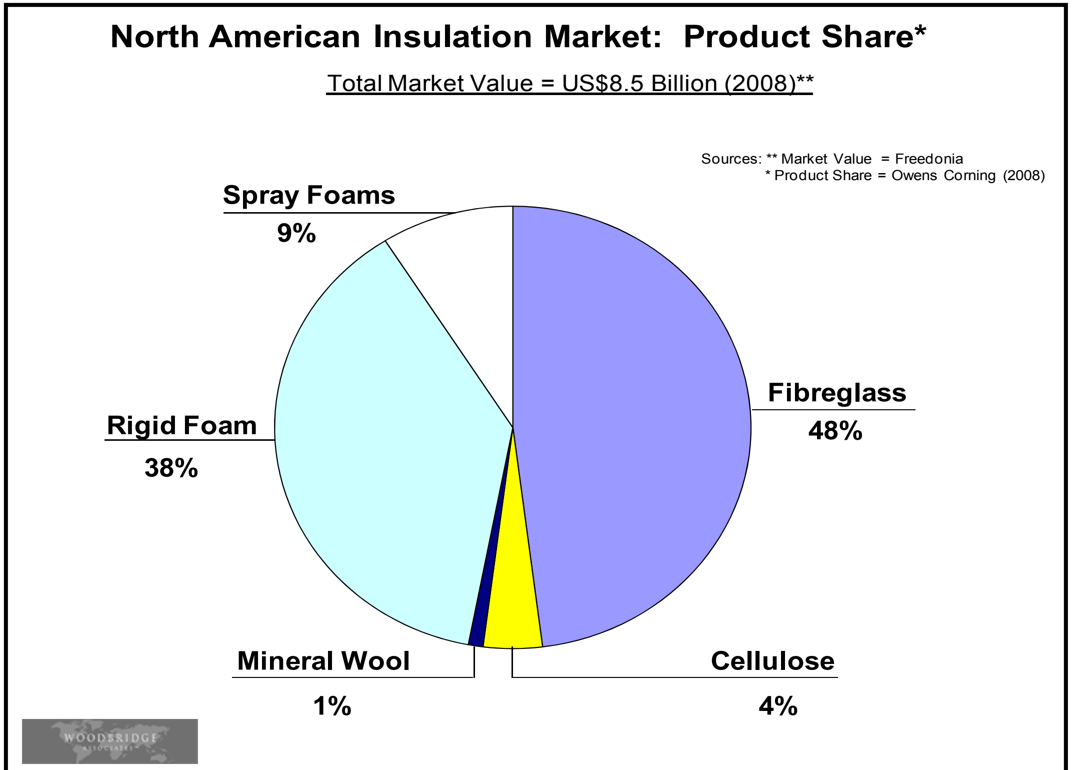


Exhibit 39

Reactive Blowing Agents Used Today in SPFs:

'A' Side

SPF Foam-Type	Reactive Blowing Agent
½ lb Open Cell	Water (with Isocyanate)
2lb Closed Cell	HCFCs (hydrochlorofluorocarbons) HCFs (hydrofluorocarbons)

Source: Trade discussions

Exhibit 40

Polyol Resins and Natural Oil Polyols

Part of 'B' Side

The ½ lb (0.2 kg) and the 2 lb (0.9 kg) foams also use polyol resins, as part of their blends on the B-side.

Production of polyester polyols from vegetable oils is becoming increasingly important.

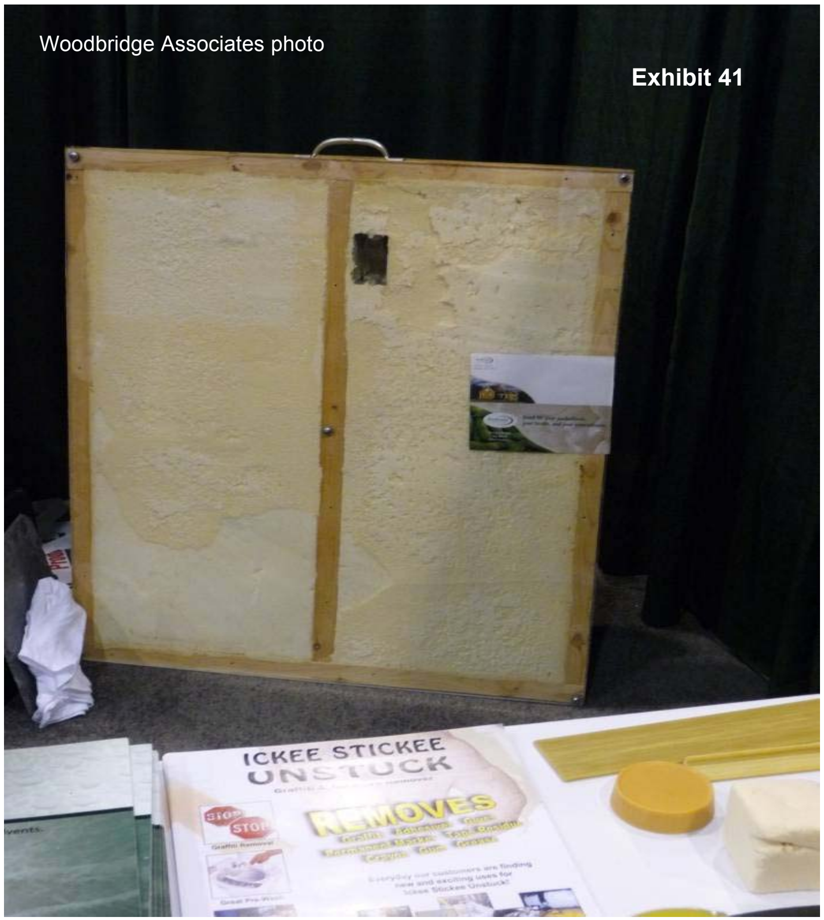
These materials are known as natural oil polyols, or NOPs.

Most NOPs qualify as bio-based products

- **Icynene** (a ½ lb open cell foam): ICYNENE LD-R-50 uses linseed oil
- **EnviroFoam** (a 2lb closed cell foam): uses soybean oil
- **Walltite Eco** (a 2lb closed cell foam): uses castor oil (Mike Holmes approved ….. uses BASF chemicals)

Manufacturing for the Insulation Contractor Market

Bulk application SPF foams are a focus of manufacturers' promotion and sales efforts at contractor and trade shows – where they compete aggressively against 'non-green' products in R-values and they also stress their competitive edge as effective air barriers (Exhibits 41 and 42).



Woodbridge Associates photo

Exhibit 41

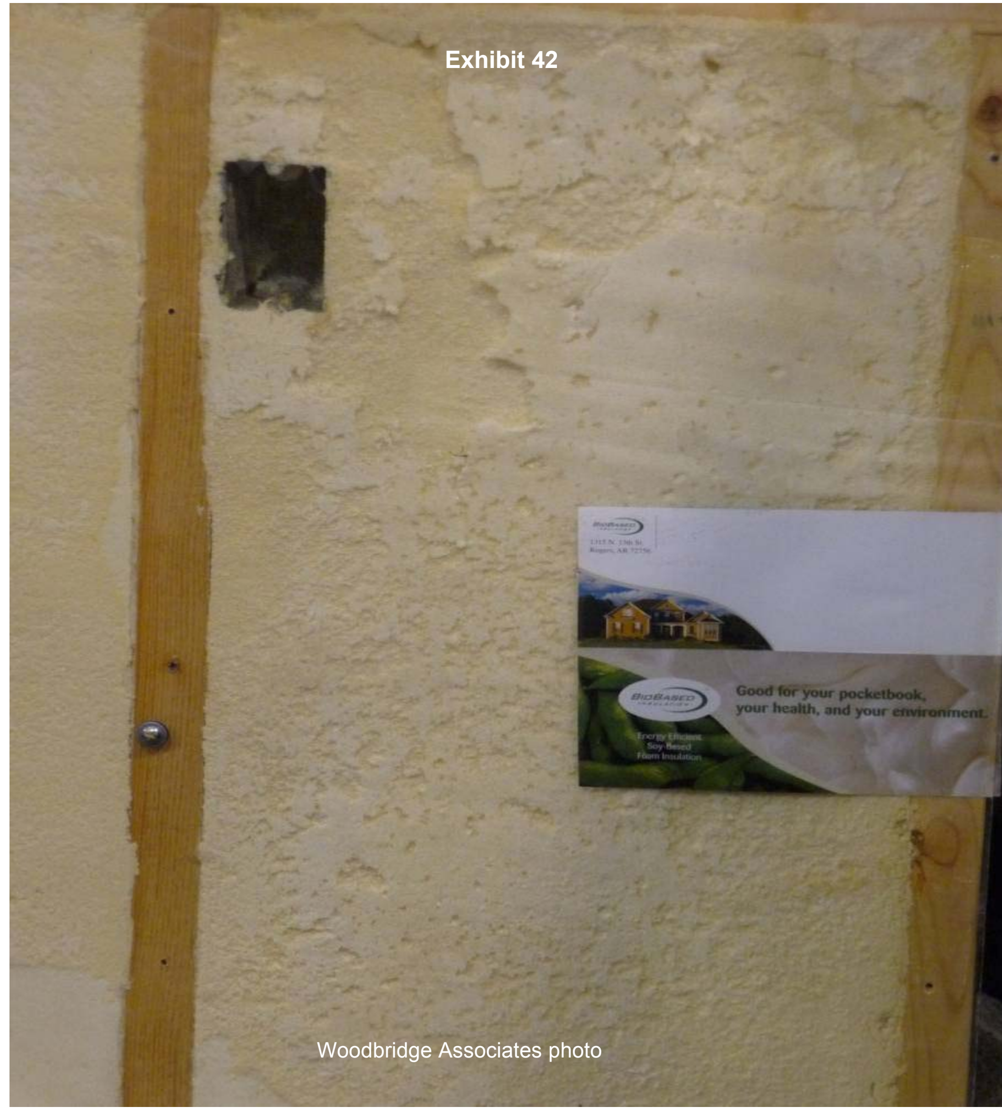
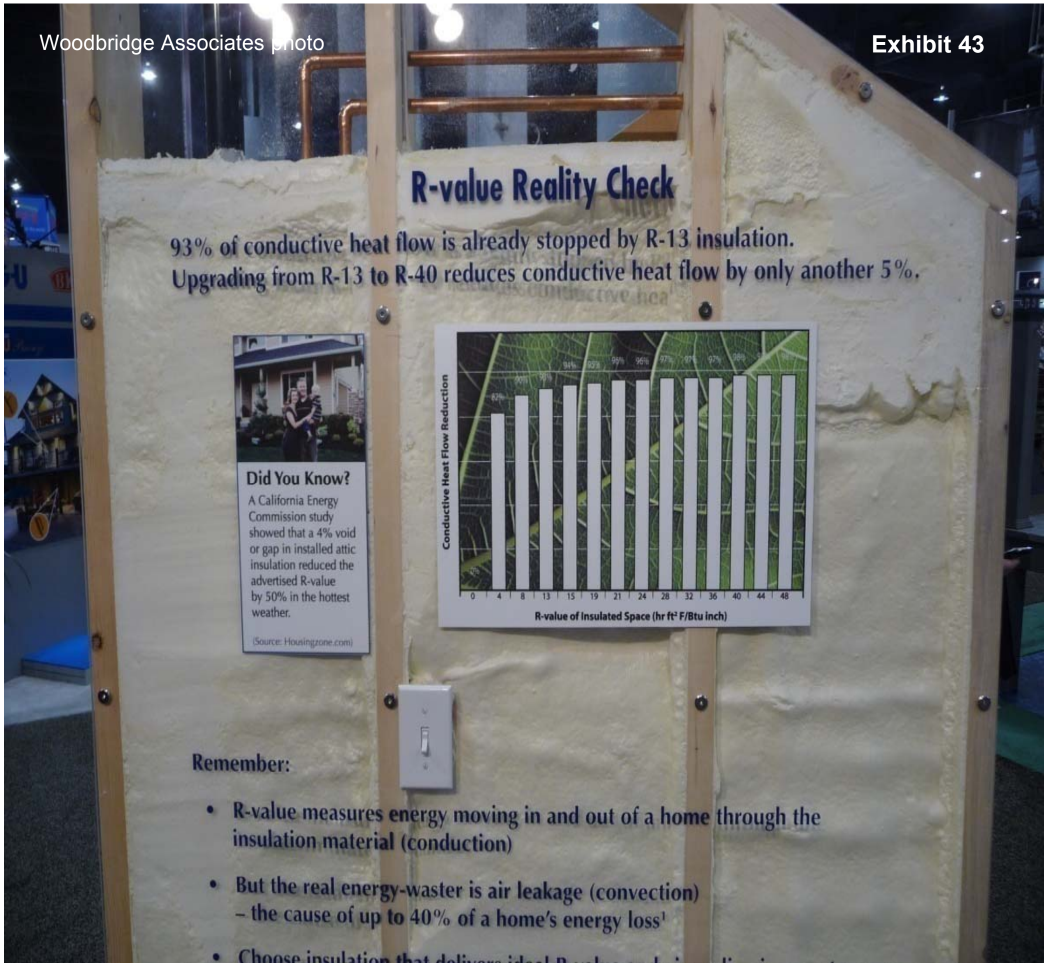


Exhibit 42

Woodbridge Associates photo

Manufacturing for the Insulation Contractor Market

Sales materials used by bulk, high volume manufacturers serving the insulation contractor emphasize the added selling point of using air barriers to offset air leakage -- which they estimate can cause up to 40% of a home's energy loss (Exhibits 43 and 44). Icynene is shown here.



Woodbridge Associates photo

Exhibit 43

Exhibit 44

Woodbridge Associates photo

SPF Manufacturing

The Do-It-Yourself ('DIY') Market: The 'Off-Gassing' Issue

For smaller jobs by the home owner, manufacturers produce aerosol products. Some, but not all, of these are 'green' products incorporating for example soy oil (Exhibit 45). A significant number of traditional products –along with many current products – made for the DIY market are not truly 'green' products (Exhibits 46 to 47). For many consumers, 'off-gassing' is an important issue. Thus the DIY market can provide a 'litmus test' of consumer views.

Exhibit 45

Small Jobs: Homeowner Applications

Traditional (and Many Current) SPF Products "Did the Job"

But Do Not Aim at the 'Green Market'

Today's Bio-Based Green Products Aim Directly at the 'Green Market'

Photos: Woodbridge Associates

Exhibit 46

Woodbridge Associates photo

Exhibit 47

SPF Manufacturing: Green SPF Products

Lack of Regulated 'Green' Standards Likely to Hold Back NOP SPF Growth

In both the bulk, high volume contractor market and the DIY home improvement market, the lack of widely recognized and enforceable standards for what constitutes 'safe' and/or 'green' products is a key issue. In our view, until it is resolved, this issue is likely to hold back the potential for NOP growth in thermal insulation products globally and in North America. This means that, instead of having two drivers in their favour (i.e. overall growth in thermal insulation demand and the switch to green products) growth in demand for these NOP products may have to rely on one major driver (overall growth) plus the potential to pick up whatever opportunistic and 'green' marketing-campaign driven market share gains can be obtained. Certainly, this will be below the full market potential for these products.

On the other hand, if it occurs, the development and adoption of industry standards, plus regulation of this aspect of the manufacturing industry, could open the floodgates to a huge surge in demand for NOP products.

Exhibit 48

Green Standards: Self-Regulation is in the Interests of the SPF Insulation Industry

- But the Larger Issue of Green Product Standards is Beyond its Scope Alone

HOLMES

Mike Holmes Approved Products

Graphics source: Walltite website

Walltite Eco Insulation is using Castor Oil, but also BASF Chemicals.

> If it occurs, the development and adoption of SPF industry standards, plus regulation of enforceable green standards of the thermal insulation manufacturing industry, could open the floodgates to a huge surge in demand for NOP products.
>
> But this is unlikely to occur unless the wider issue of green standards generally is addressed effectively.

> Without enforceable green-content standards, pioneering SPF products using NOPs –such as Walltite (castor oil) and Icynene (linseed /flax oil) are unlikely to enjoy the market share gains that their market potential would otherwise indicate.

Without enforceable green-content standards, pioneering SPF products using NOPs –such as Walltite (castor oil: see Exhibit 48), Icynene (linseed/flax oil) and EnviroFoam (castor oil) are unlikely to enjoy the market share gains that their green market potential would otherwise indicate.

Without product standards, it is financially unwise for insulation manufacturers to pioneer new products using extensive green chemical content in their formulations – except where they have an evident financial payback.

With such standards, however, the potential for the 'green' SPF sub-sector to gain significant market share is immense. Correspondingly, the demand for NOPs would follow.

3.2 How do the Various Thermal Insulation Products Compare?

3.2 How do the Various Thermal Insulation Products Compare?

Most consumers do not look formally at 'logical' factors, such as energy efficiency, convenience, air barrier values, differences in prices and cost and building codes when making their insulation decisions.

More broadly, they are generally aware of the 'pocketbook' and 'planet' issues referred to elsewhere in this report. Generally, most consumers are aware of R-Value ratings, but this is at a rudimentary level in most cases. That is, they do not know enough about the subject to come to an informed decision about the optimum thickness of insulation required, or the best balance of other factors –such as conductive heat flow (CHF) and any air barriers required.

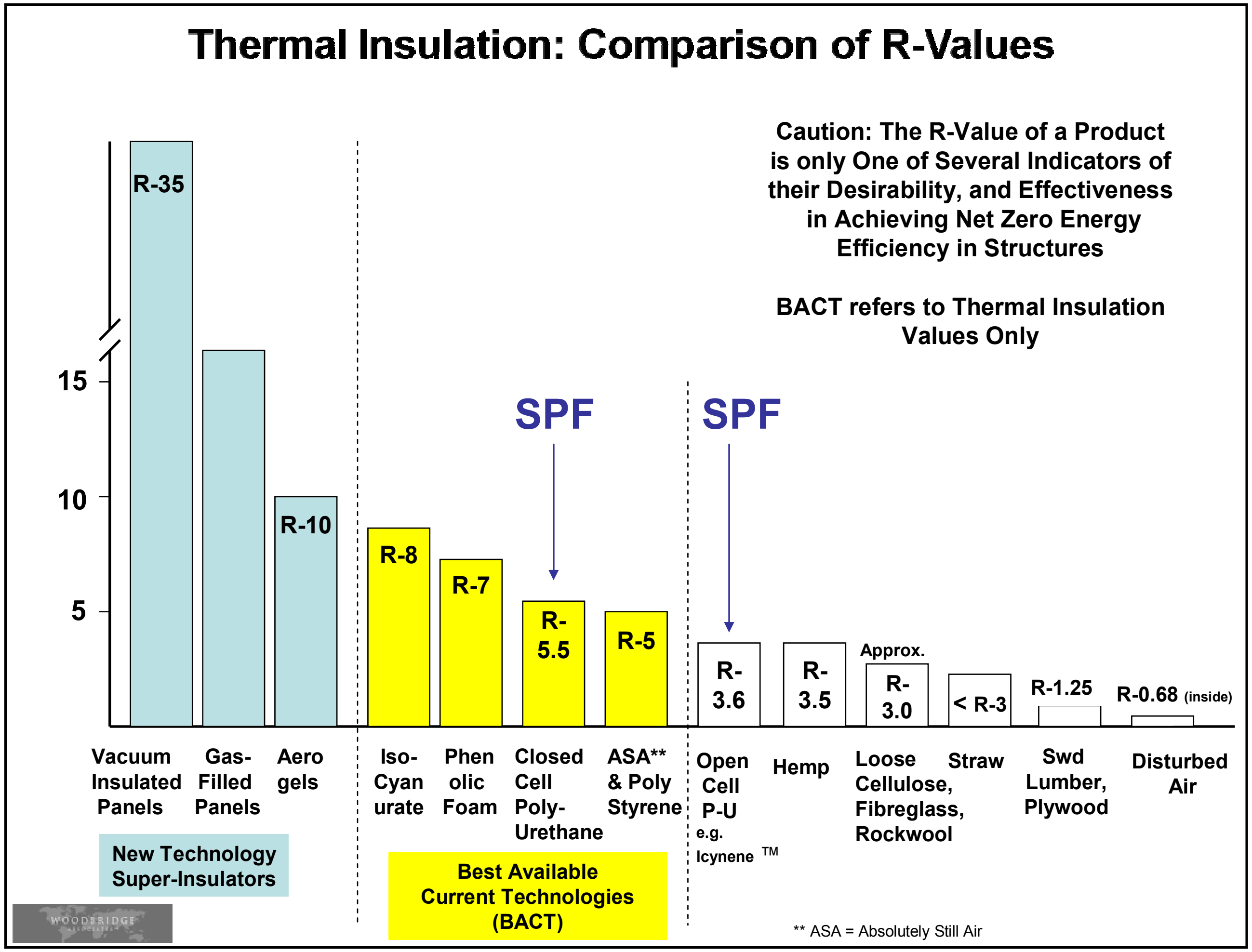
They rely instead, in most cases, on homebuilders in the case of purchasing a new home or renovation contractors –and retail sale people – when carrying out a renovation or DIY project. Budget is a key issue for most consumers.

Exhibit 49 shows the various R-Values for different types of insulation products. As already noted, R-value is an important but only one of several factors to be considered. Some of the new technology super-insulators are designed for special purposes – not general application. For most purposes, best available technology (BACT) is the key R-Value issue.

In its advertising, Icynene points out that "93% of conductive heat flow [CHF] is already stopped by R-13 insulation. Upgrading from R-13 to R-40 *reduces CHF* by only another 5%".

It is clear that, from the viewpoint of many North American consumers, informed choices between the various 'green' insulation products are difficult to make.

Exhibit 49



4.1 Global Overview: Oilseeds Production, Oils and Issues for Growers

Natural Oil Polyols: Agricultural Issues

The business case for NOPs, and for Canola oil and flax oil specifically, as a potential feedstock in spray-on-foams, depends in part of the price and availability of these compounds. Canola oil and flax oil are of particular interest to the sponsors of this study because of the potential for creating new demand for these crops within Alberta.

Globally, there are many choices of oilseeds.

World major oilseed production during 2008/09 totaled 408 million tonnes, compared with 227 million tonnes produced in 1993/94. Soybeans are the largest by volume (Exhibit 50).

Assuming that global production roughly equates to global demand, this represented a compound annual growth rate (CAGR) in world consumption of just under 4% annually over the period. Of this, soybean oilseeds accounted for 55% of the total, and grew at a CAGR of 5.5% up until their peak production in 2006/07.

Canola (which also includes rapeseed outside Canada) accounted for 14% of total major oilseeds global output (and demand) in 2008/09, and – with a CAGR of 5.2% – grew at a similar rate of increase as soybeans. Other oilseeds grew more slowly in output.

Processed Products

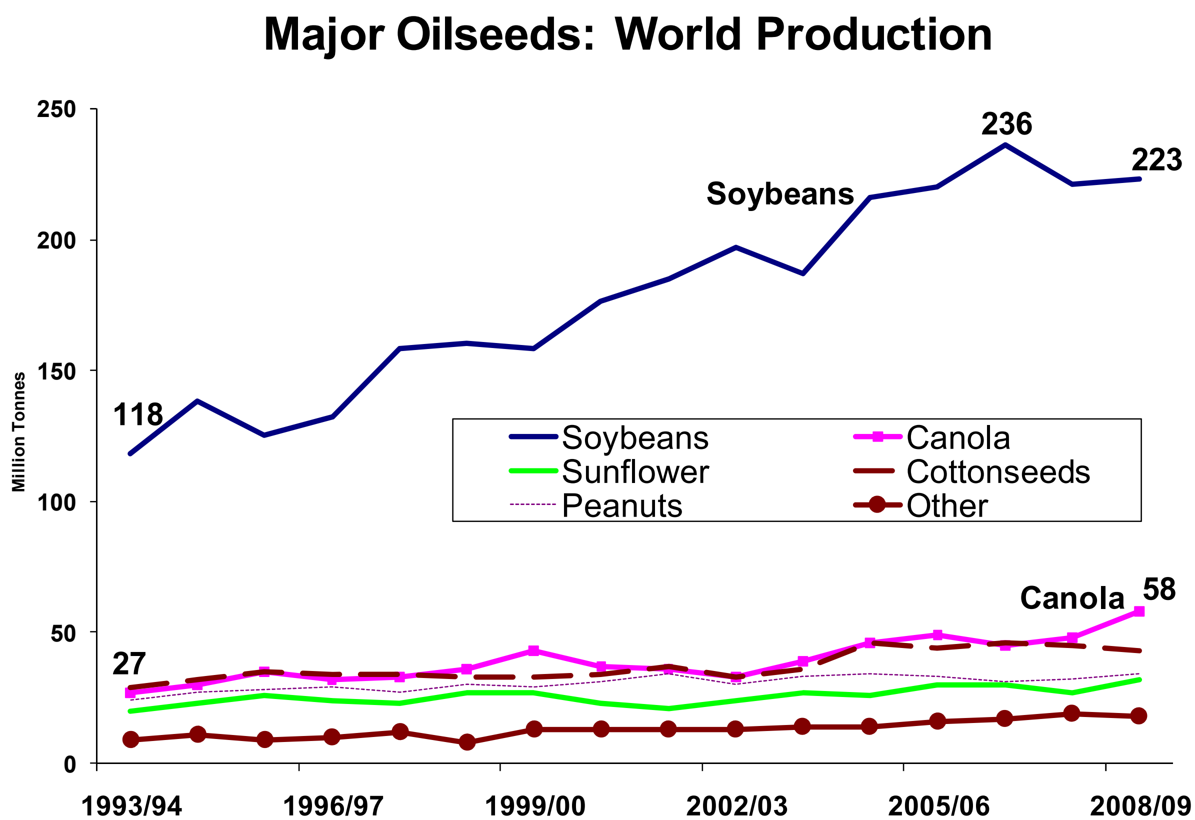
Oilseeds are processed into two major groups of products, along with numerous sub-groups:

- Oils
- Meal (including de-hulled seeds)

Oils are the focus of this report, but it is worthwhile noting that there are significant differences in the volume yield of oil from the various oilseeds, and in several other characteristics (such as protein content in the meal). Soybeans are widely grown, for example, but have a comparatively low yield of oil from the crushing/extraction process (around 17-18% volume yield).

In addition to the two major oilseed products (oil and meal), growers also take into consideration the various fibres and related products that can be produced from these crops.

Exhibit 50



Data source: USDA

Global Oil and Meal Production

As already noted, soybeans dominate global production of oilseeds. The low volume yield of soybean oil gives a hint to the other major motivation for farmers to grow this crop – protein sued for animal feeds. Exhibits 51 and 52 provide a valuable illustration of this point. By virtue of the area grown worldwide, although soybeans used for oil production dominate the vegetable oils industry they are even more significant comparatively in meal production.

From 1993/94 to 2008/09, soybeans used for oil production yielded 36 million tonnes of oil – doubling over this period. Not surprisingly, soybeans used for meal production increased at a similar rate – but far over-shadowed Canola and other crops in the volumes of meal produced. In 2008/09, soybean meal production totaled 154 million tonnes worldwide compared with only 31 million tonnes for Canola.

As we will show later, the choice of the "best" vegetable oil for producing NOPs for SPF insulation depends on a wide range of factors. Two are notable here. Firstly, it is clearly evident that – in terms of the actual volume produced and available globally – soybean oil is the most widespread. On the other hand, many oilseeds have a high opportunity cost (i.e. alternative uses) in terms of animal feed (as shown here in the case of soybean) and fibre (e.g. in the case of flax, used in producing linoleum).

Exhibit 51

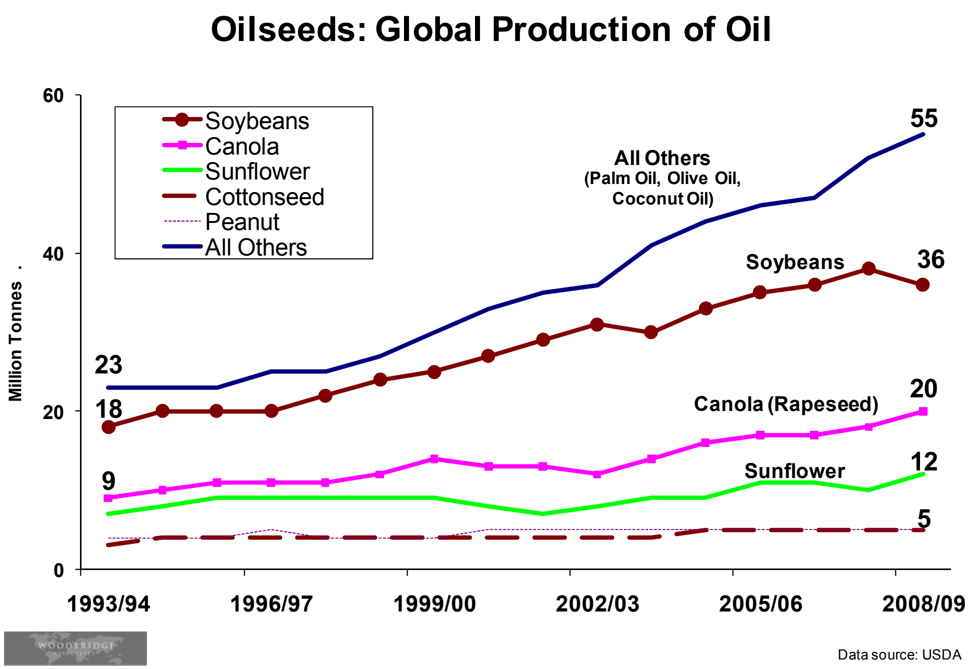
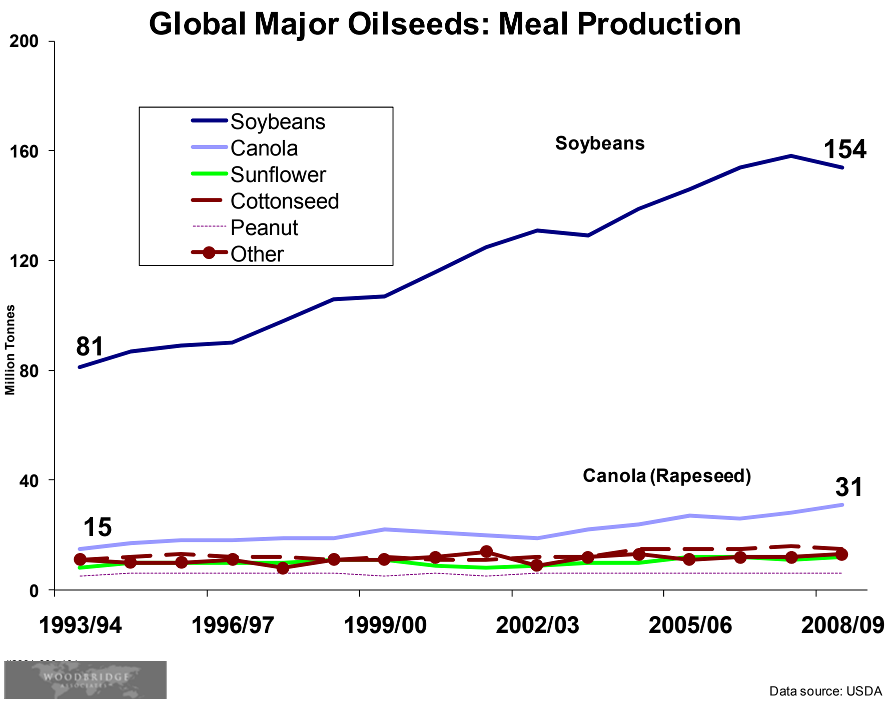


Exhibit 52

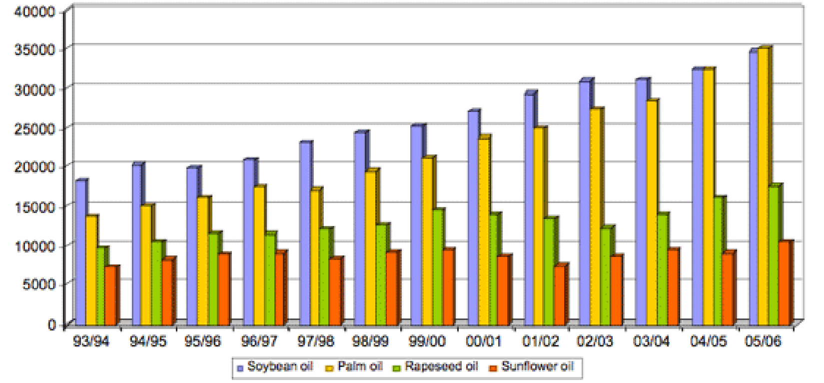


Global Vegetable and Fats Production

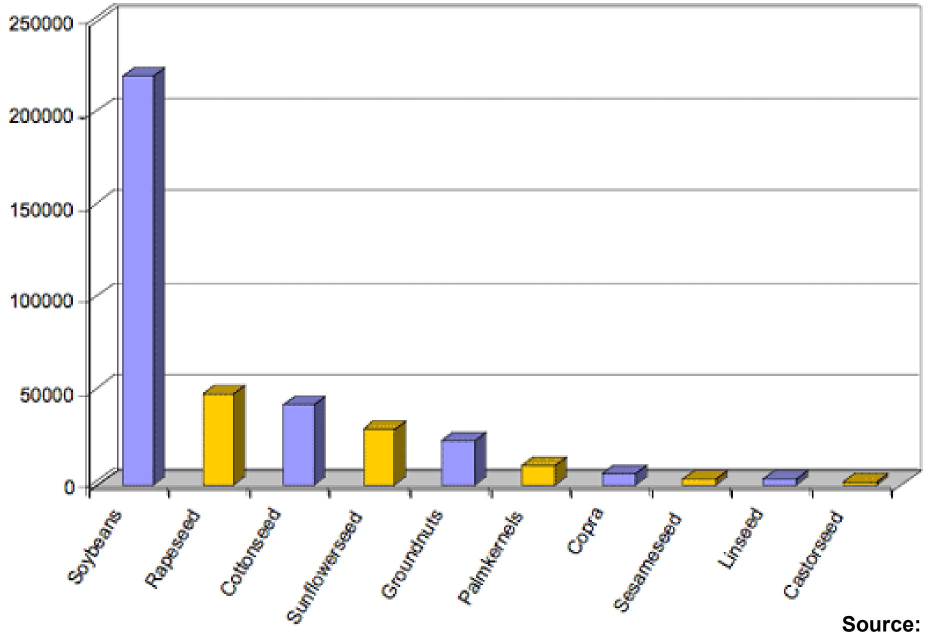
Exhibit 53 shows world production of the major oilseeds for 2005/06. Soybeans represent 39 % of the total world production. Palm does not appear in this figure since the palm fruits cannot be transported and are processed on the spot (source: FEDIOL). Figure 54 shows world production of the major vegetable oils and fats for the same period. In this figure, soya oil, compared with the rest of the commodities, is not in such a predominant position because of the low yield of soybeans. Crude palm oil is considered a raw material in itself, since it is normally refined and even re-refined.

The global trend in oils production is interesting, and is shown in Exhibit 55 for the period since the 1993/94 growing season. Over the last 10 years, the production of soybean oil and palm oil has almost doubled, dominating the market. Over the same period, rapeseed oil and sunflower oil production have varied only slightly (source: Fediol).

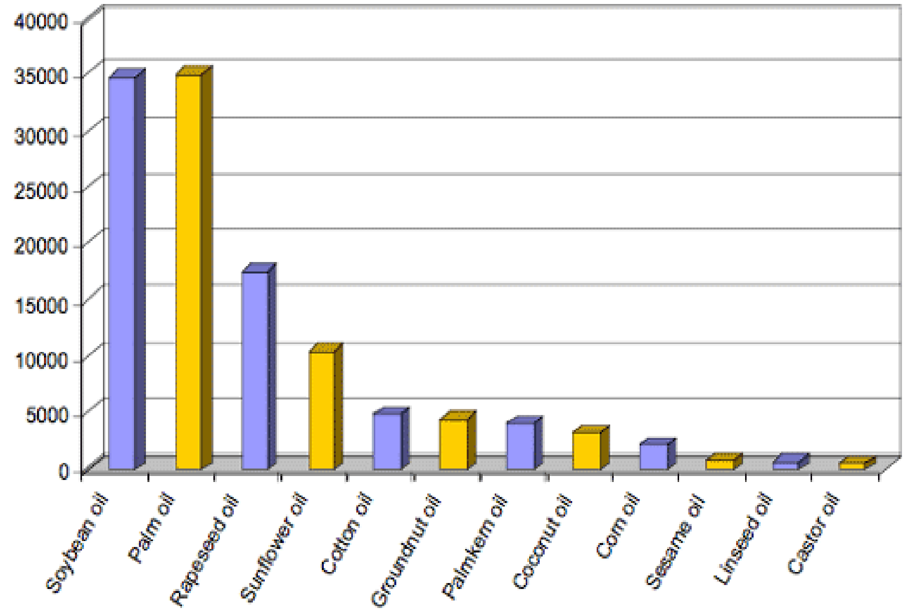
Trend in Global Oil Production. Million tonnes **Exhibit 55**



Oilseeds World Production 2005/06. Million tonnes **Exhibit 53**



Oils and Fats World Production 2005/06. Million tonnes **Exhibit 54**



Source: Fediol

Oils and Fats Production by Main Countries

Exhibit 56 shows world production of selected vegetable oils and fats and its distribution by main country of origin (2005/06 data).

Malaysia is by far the largest producer of palm oil , but is a comparatively minor producer of other oils. The same is true for Indonesia.

China is an important oils producer, particularly in soybeans. Interestingly, soybeans were grown in China long before they were cultivated in the USA. In fact, soybeans were first introduced from China into the USA when they were used as ships' ballast and were first discharged onto docks in the Washington DC-Virginia region in the early 1800s.

As noted in the Exhibit, soybeans dominate vegetable oils production in the USA.

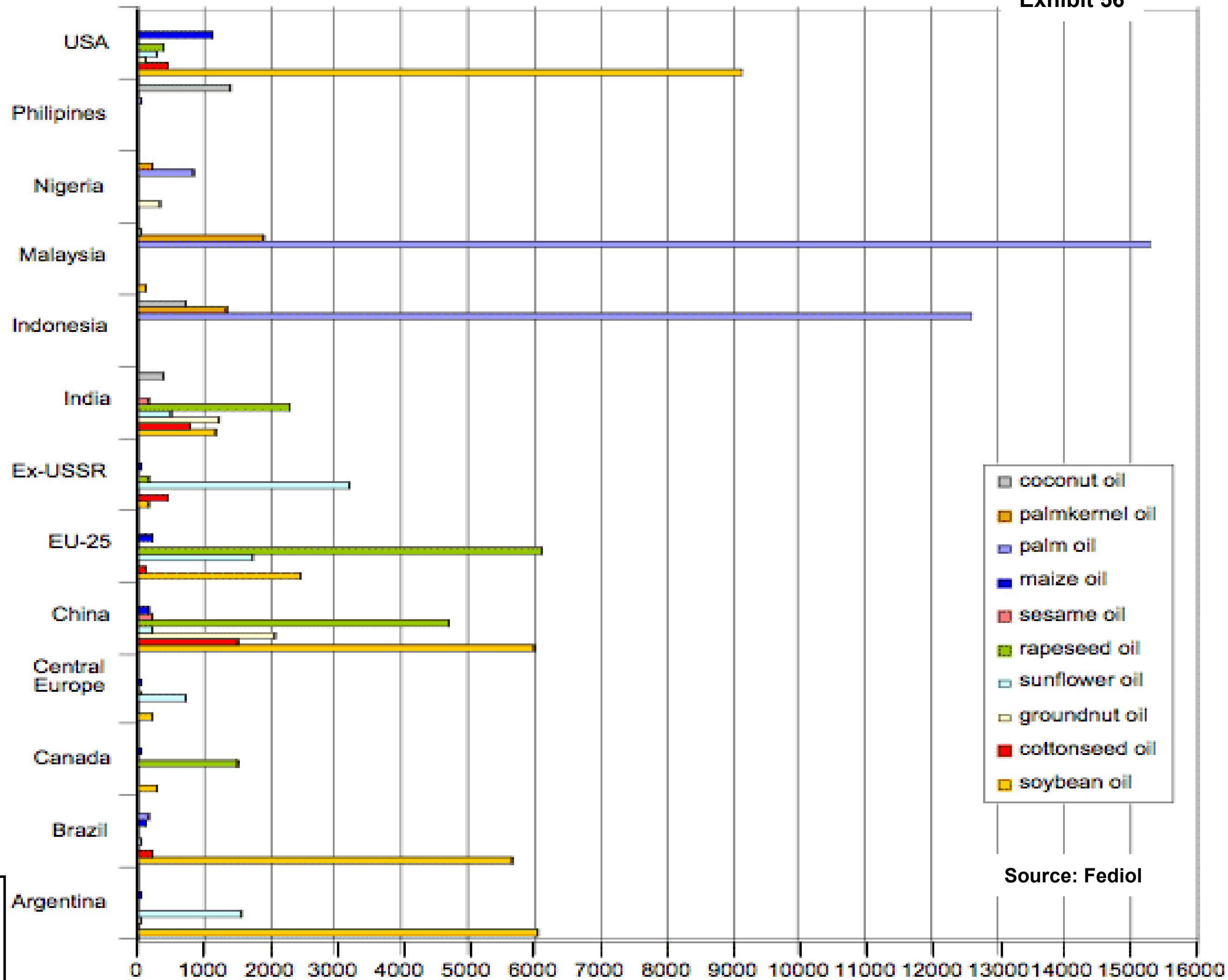
The global position of Canada is important to this report, and is shown alongside. Rapeseed oil (modified to Canola in Canada) clearly is very important nationally. Brazil is another major producer – using large volumes of soy oil for bio-diesel and creating a food vs. commercial crop public policy dilemma.

Oils production in the European Union is significant, and stresses rapeseed mainly for fuel use.

Rapeseed oil has also become the primary feedstock for biodiesel in Europe. In 2006, more than 4.0 million tons of rapeseed oil went into biodiesel. That volume has since increased.

Oils and Fats Production by Main Countries

Exhibit 56



Source: Fediol

Canola (and Rapeseed) Production

Description and Cultivation

Rapeseed, also called colza, is a member of the Cruciferae family and grows to a height of 75-175 cm. It has yellow flowers, blue-green leaves and is heavily branched with deep, fibrous taproot. The seeds are small, round and black-red in colour.

Rapeseed comprises several different varieties within the Brassica family which are very similar: Brassica napus (rapeseed) and Brassica rapa (turnip rapeseed). Rapeseed is one of the oldest cultivated plants on earth, from antiquity right down until the nineteenth century; rapeseed oil was used mainly for lighting and as a lubricant, today, rapeseed oil is one of the most important vegetable oils for human consumption (source: Fediol)

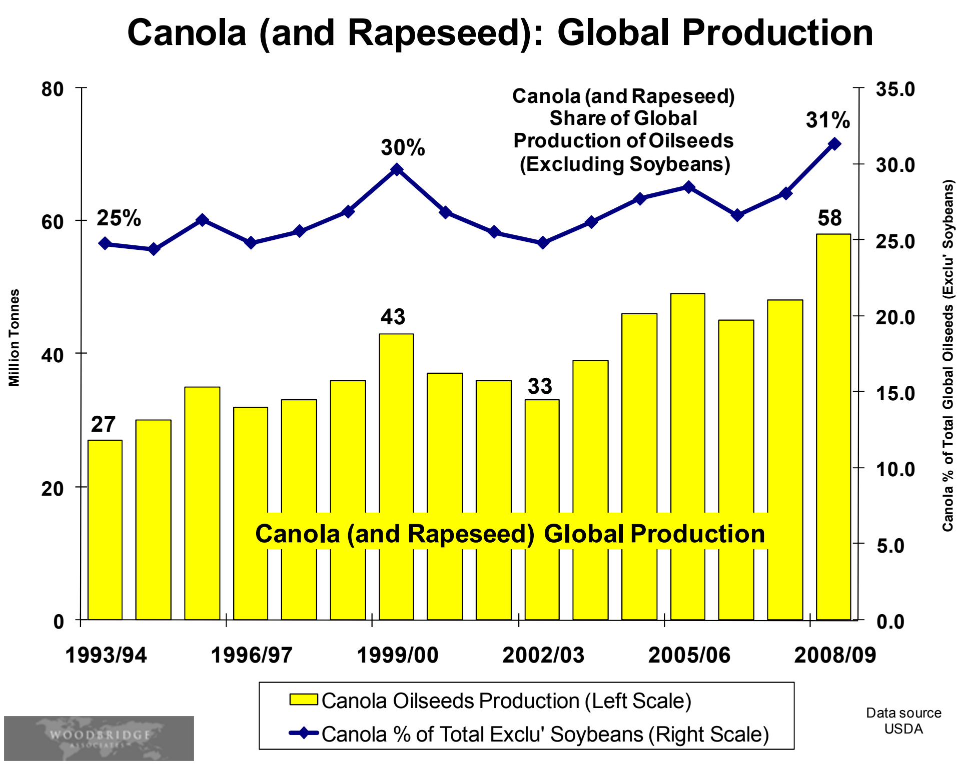
Rapeseed has become the special oil plant of northern Europe. Large areas are cultivated in the European Union, Poland and the Czech Republic. Outside Europe the dominant producers are China, India, Canada (Canola) and Australia. Globally, it is an important crop with rising output (Exhibit 57).

As noted by Fediol, rapeseed is planted either in the autumn (winter varieties) or in the spring (summer varieties). The winter varieties have a longer vegetation period and give a better yield, but can only be grown in areas with a mild winter climate. In Europe winter rapeseed is the dominating variety, whereas in Canada only summer rapeseed is grown. The harvest period in the Northern Hemisphere starts in late July for the winter varieties, in late August or early September for the summer varieties.

Rapeseed oil and meal

As the oil content of rapeseed is around 40%, the processing is made in two steps: pre-pressing plus solvent extraction, or only by pressing. The rapeseed meal is an important protein source in compound feed for cattle, pigs and poultry. Fediol notes that rapeseed oil contains 98% of tri-esters of fatty acids and 2% of sterols and tocopherols. It has a uniquely low content of saturated fatty acids and a high content of monounsaturated fatty acids, offering a good balance of fatty acids: 60 % oleic, 20 % linoleic, 10% alphalinoleic. It is also a rich source of Omega 3 and Omega 6 linolenic acids.

Exhibit 57



The low erucic variety is widely used for applications such as salad dressing, margarines and sauces. The high erucic variety is used in a range of technical purposes, for example bio-degradable lubricating oil as an alternative to mineral oil based lubricants. The use of rapeseed oil methyl esters as a substitute for diesel fuel takes large volumes of rapeseed oil. Fediol also notes that rapeseed meal, with only 37% protein content cannot substitute soymeal in animal feeding.

Global Oil and Meal Production

Exhibit 58 provides a comparison of the various yields of oil and meal for a variety of crops (vegetable oil plants and trees yielding oil). The highest oil yields are obtained from copra – yielding roughly 64% oils and 35% meal. Soybean is noticeable for the other extreme, yielding around 17.5% oil in this case, and 73% meal.

Importantly, for the purposes of this report, linseed/flax and Canola oil (rapeseed in this instance) yield around the same percentages of oil (37%-39%) and meal respectively.

Exhibit 58

Comparison of Oil Yields and Meal Yields (Approximate Percentages)

Crop	OILS			MEALS		
	standard	minimum	maximum	standard	minimum	maximum
Groundnut	47.5	36.1	44.4	51.5	52.0	61.1
Soya	17.5	16.0	19.4	80.0	73.2	81.0
Rape	39.0	40.0	43.0	56.0	54.9	57.1
Sunflower	42.0	36.2	43.9	39.0/55.0*	54.8	60.8
Cotton		13.0	18.0		52.0	53.0
Copra	63.5			35.0		
Palm kernel	46.0			52.0		
Lin/Flax	37.0	29.7	38.5	60.0	62.0	69.6
Castor	47.0	45.0	46.0	(+)	(+)	(+)
Maize germs	48.0	35.0				
						62.0

(*) Sunflower yield for meals goes from 39% for dehulled seeds to 55% for non-dehulled seeds.
(+) Castor meals, which are not used in animal feedstuffs, are not taken into account.

Source: FEDIOL http://www.fediol.be/2/index.php

Fediol notes that trees yielding oil bearing fruits take a few years to become established, but thereafter are capable of producing crops on an on-going basis for many years. The yield obtained is subject to variation year by year, either as a result of climate conditions or due to stress factors associated, for instance, with the size of the previous crop. A typical example of a tree yielding oil-bearing fruit is the palm.

The standard values given in this Fediol data are conservative estimates. Crop yields can vary widely. For soy, rape, sunflower and flax, standard means yields which correspond to quality types (standard) of European Community (EU) seeds. For groundnut, cotton, copra, palm kernel, castor and others, standard refers to yields obtained from average quality types over several years. In the Exhibit, the minimum and maximum are punctual values related to extreme yields obtained from the actual quality of the seeds.

Canada is the world's largest producer and exporter of flaxseed, but processing comparatively little of the crop domestically.

Flax Oil Production and Processing Globally

Bast Fibre and Oil/Meal Production

As shown earlier, flaxseed is not among the major oilseeds produced worldwide, but it also is a bast fibre crop – notably in Europe, and thus has special significance regionally. Even so, flax as a bast fibre crop has minimal significance globally compared with other fibrous crops.

Canada is by far the largest oil flaxseed (linseed) producer worldwide. For data comparison purposes, the growing season 2005/06 is used as an indicator of more 'normal' production times versus the current global recessionary and lower demand conditions. In that period, Canada accounted for almost 40% of the world's linseed production (Exhibit 59). However, as the chart shows, Canada is not a globally significant producer of linseed oil (flax oil) or meal. The explanation is exports.

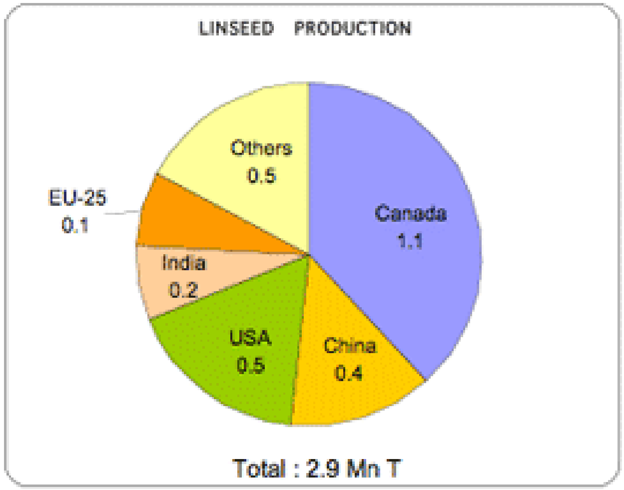
Canada is a major global exporter of linseed / flaxseed to Western Europe (particularly Belgium) which accounted for nearly 70% of Canada's exports of this crop, along with the United States (20%).

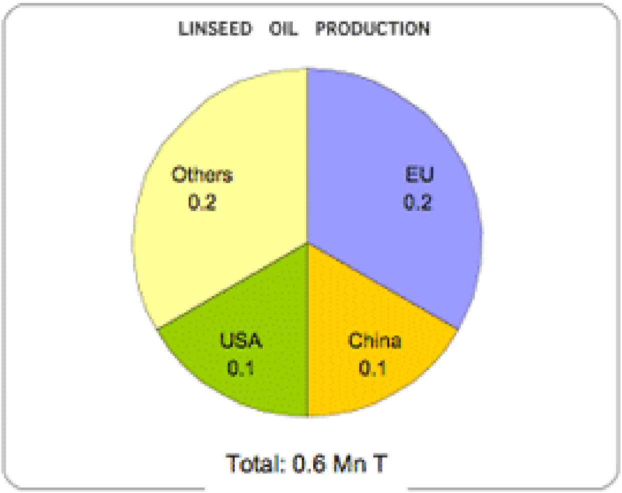
Globally, the largest producers of linseed oil (flax oil) are the E-U, China and United States. As shown later in this section, unlike Canola oil in which Canada has been increasing its exports in recent years (despite a strengthening C$ in US funds), its exports of both linseed oil /flax oil and soybean oil have been declining.

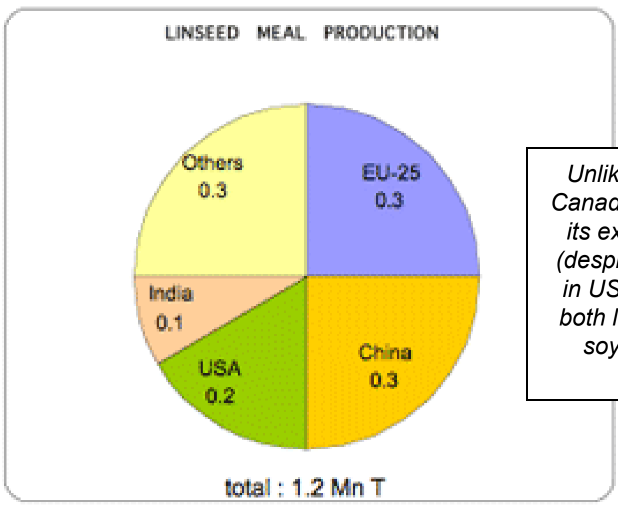
Linseed meal production is significant globally, and is especially important as an animal feedcrop both in the E-U and China – which together account for about half of world production.

Other important producing areas in oil and feed include India (where generally it is not extensively cultivated as a bast fibre) and a wide range of other countries. It is interesting to note that the European Union strongly supports flax cultivation for fibre with a subsidy reported to be around US$800/ha for flax farmers and scutchers (source: Euroflax #109, page 16).

Exhibit 59







Unlike Canola oil in which Canada has been increasing its exports in recent years (despite a strengthening C$ in US funds), its exports of both linseed oil /flax oil and soybean oil have been declining.

Source: FEDIOL

4.2 Canola Oil and Flaxseed Oil in Canada and Alberta

Canola Oil in Canada and Alberta

Canadian Production in the Global Context

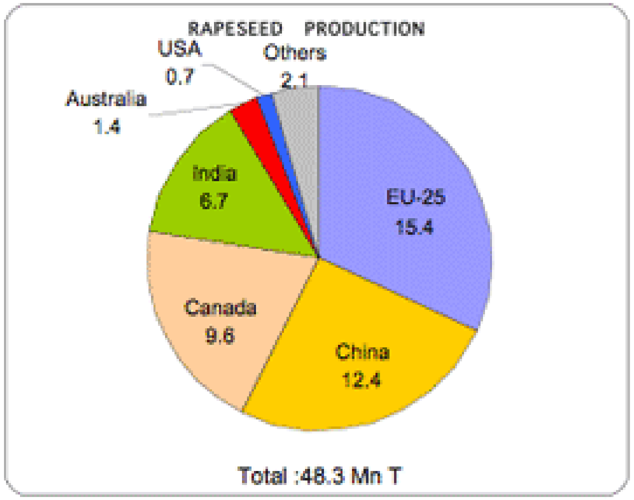
Canola (a trademarked brand name) is a variety of rapeseed that was developed in the early 1970s using traditional plant breeding techniques by Canadian plant breeders. The goal was to remove the anti-nutritional components (erucic acid and glucosinolates) from rapeseed to assure its safety for human and animal consumption (source: Fediol).

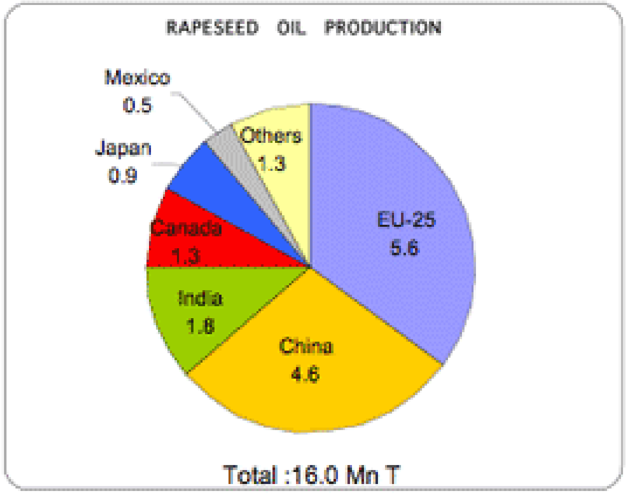
In this report, the names rapeseed and Canola are used interchangeably.

Exhibit 60 shows the position of Canada within the context of global production of rapeseed. Worldwide, the largest producers of rapeseed are the E-U, China, Canada and India. In 2006, Canada accounted for around 20% of world production. China is a very large producer, with over 25% of global output in 2006. Worldwide, the largest producing region is the E-U, accounting for nearly one-third of total output.

Exhibit 60

Global Production of Rapeseed and Canola





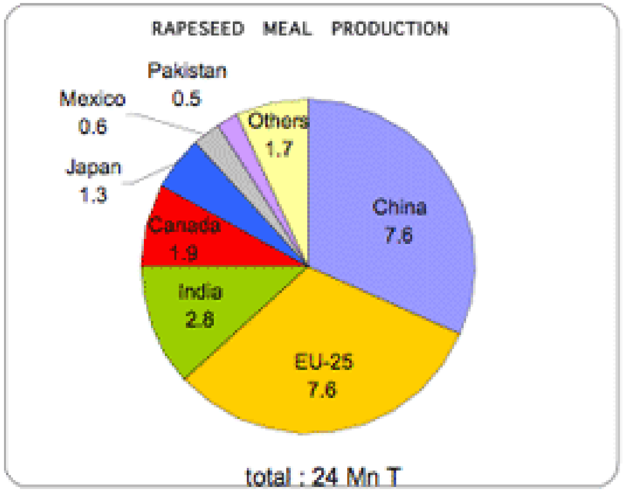
Rapeseed /Canola Oil Production

In oil production, the relative positions of the key supply areas differs.

Compared with its 20% production share in oilseed, Canada supplied about 8% of total global production of rapeseed/Canola oil in 2006. Proportionally to seed production, China accounted for the greatest volume yield of oil – processing nearly 30% of the world's output . The E-U produced roughly the same output of oil to oilseed – again around one-third of the world total.

Meal Production

Canada's position regarding meal production is summarized in the Exhibit. It is the world's 4th largest producer, accounting for around 8% of the global total in 2006, according to Fediol statistics.



In 2006, Canada accounted for around 20% of world production of rapeseed /Canola.

Canola Oil Production and Processing in Canada and Alberta

The previous charts suggest that, for Canadian growers, meal production from Canola is relatively less important than oil production – as might be expected given the human consumption goals of Canola production and processing. As noted, Canada produces around 20% of the world's supply of rapeseed/Canola oilseeds, but only around 8% of the oil and meal production globally. The extracted oil content is focused on the desired grades of oil. Exhibit 61 provides a longer term perspective of the volumes of seed crushed in Canada compared with Canola oil produced. Although there have been some marked cycles in Canada's overall growing and processing activity in Canola, notably in the late 1990s, the trends in output have been strongly upwards. However, volumes of seed crushed have exceeded the rate of growth in Canola oil produced.

The growing situation within western provinces differs somewhat from the picture of Canada overall. Exhibit 62 shows that there was very little slowdown in Canola deliveries in Alberta and Manitoba during the late 1990s cycle for Canada overall. Moreover, in recent years, Alberta has become the largest region for grower deliveries to processing plants – with deliveries exceeding 3.8 million tonnes in 2008.

Exhibit 61

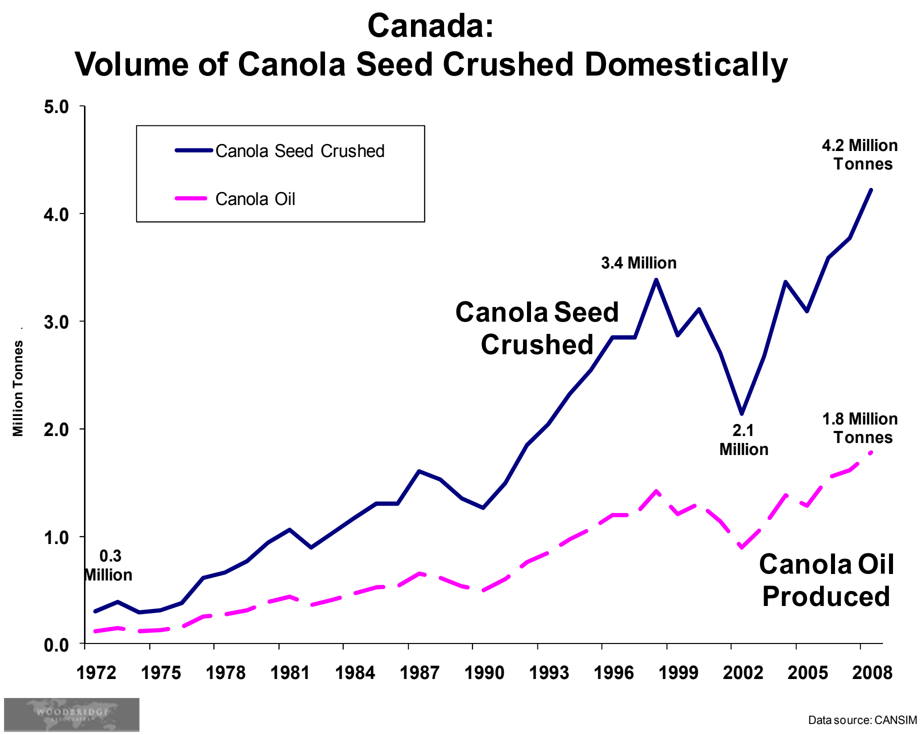
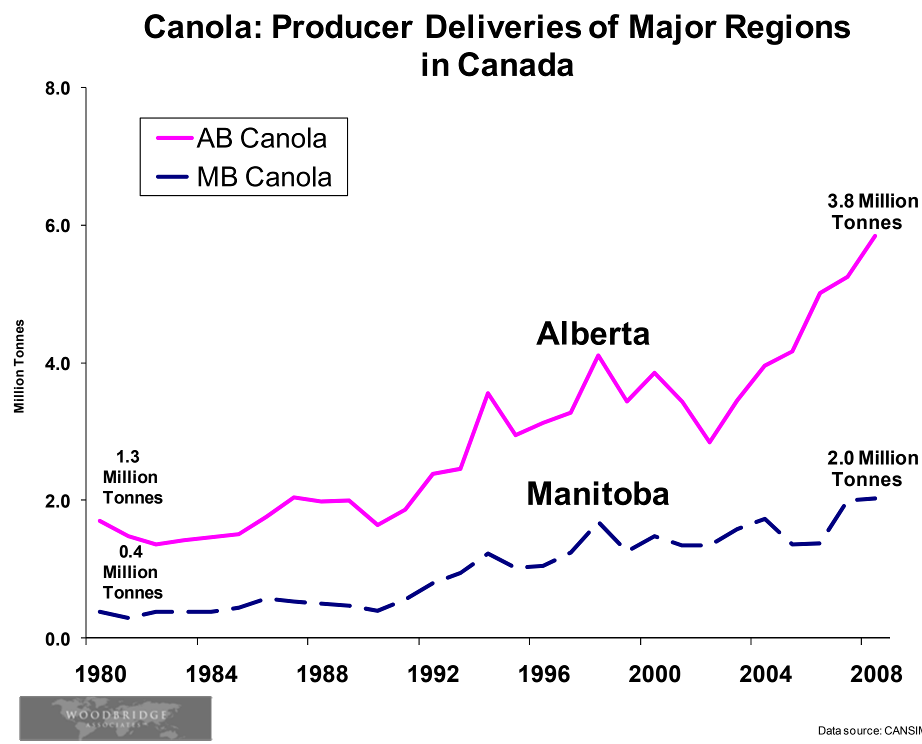


Exhibit 62



Flax Oil Production and Processing in Canada and Alberta

Flax: A 'Western Canadian' Crop

It is worthwhile noting at the outset that flax is virtually exclusively a western Canadian crop. Almost all of the flax grown in Western Canada is destined for the export market. The Flax Development Commission** notes that Saskatchewan, on average, produces four times as much volume as Manitoba, and has been the largest producing province since 1993-1994. Just over 1 of every 4 farms in Saskatchewan include flax as part of their rotation, according to Saskflax. In Canada, only a relatively small amount of flaxseed is crushed for oil. Flax is ground for the inclusion in baked goods and is fed to livestock, especially poultry. Food use is expected to expand as nutritional awareness increases. Canada also exports small volumes of flaxseed oil, flaxseed meal, and some flax fibre.

Recent Trends in Growing

Alberta accounted for less than 3% of western Canada's flax production in 2007/08 (Exhibit 63). Moreover, the volume produced, 16,000 tonnes, indicates that this is a modest crop for growers in Alberta in comparison with (a) Saskatchewan and Manitoba and (b) other crops, such as Canola (see statistics later in this section).

Production of flax in Canada (western Canada) peaked at over one million tonnes in 2005/06.

There has been a 40% decline since that time, although Agriculture Canada surveys indicate that the intended area under flax cultivation (and other crops) is expected to increase in 2009/10.

Overall, the trend since 2000/01 has been mixed, with the peak season of 2005/06, and subsequent period 2006/07, appearing to be a statistical abnormalities. In fact, this may not be the case. Canada's global exports have been affected badly by the current global recession. Demand from processors has declined, both in Europe and the United States. Medicinal demand for flax oil is expected to increase over time, and Canada's important position of an exporter of linseed suggests that the acreage under cultivation could rise – but Canola is a strong competitor for land.

Flax Production in Western Canada 000 tonnes — **Exhibit 63**

Period	Manitoba	Saskatchewan	Alberta	Western Canada Total ***
2000/01	206	470	18	693
2001/02	199	495	20	715
2002/03	215	445	20	697
2003/04	196	533	25	754
2004/05	132	356	29	517
2005/06	147	881	53	1082
2006/07	193	760	36	989
2007/08	105	512	16	634
2008/09				Not Yet Available

Source: http://www.flaxcouncil.ca/english/index.jsp?p=statistics2&mp=statistics

** Saskatchewan Flax Development Commission

*** Data may not add horizontally due to rounding http://www.saskflax.com/sellingmyflax.html *www.saskflax.com*

Flax Oil Production and Processing in Canada and Alberta

Canola Dominates Among Growers' Priorities

The success and importance of Canola to western growers is readily apparent from Exhibit 64, which shows Canola oilseed deliveries compared with flax oilseeds. For the region as a whole, flax oilseeds deliveries declined over the three growing seasons to 2008/09 from 654,000 tonnes to 498,000 tonnes. As already noted, this may be correlated with the decline in global demand.

Canola seed deliveries, however, rose from 8,158,000 tonnes to 10,741,000 tonnes over the same period.

Clearly, demand (and prices) for these two crops are driven by different factors. In the case of Canola, these include very strong markets in China (36% of Canada's 2008/09 Canola exports) and Japan (27%) as well as different end use consumption patterns.

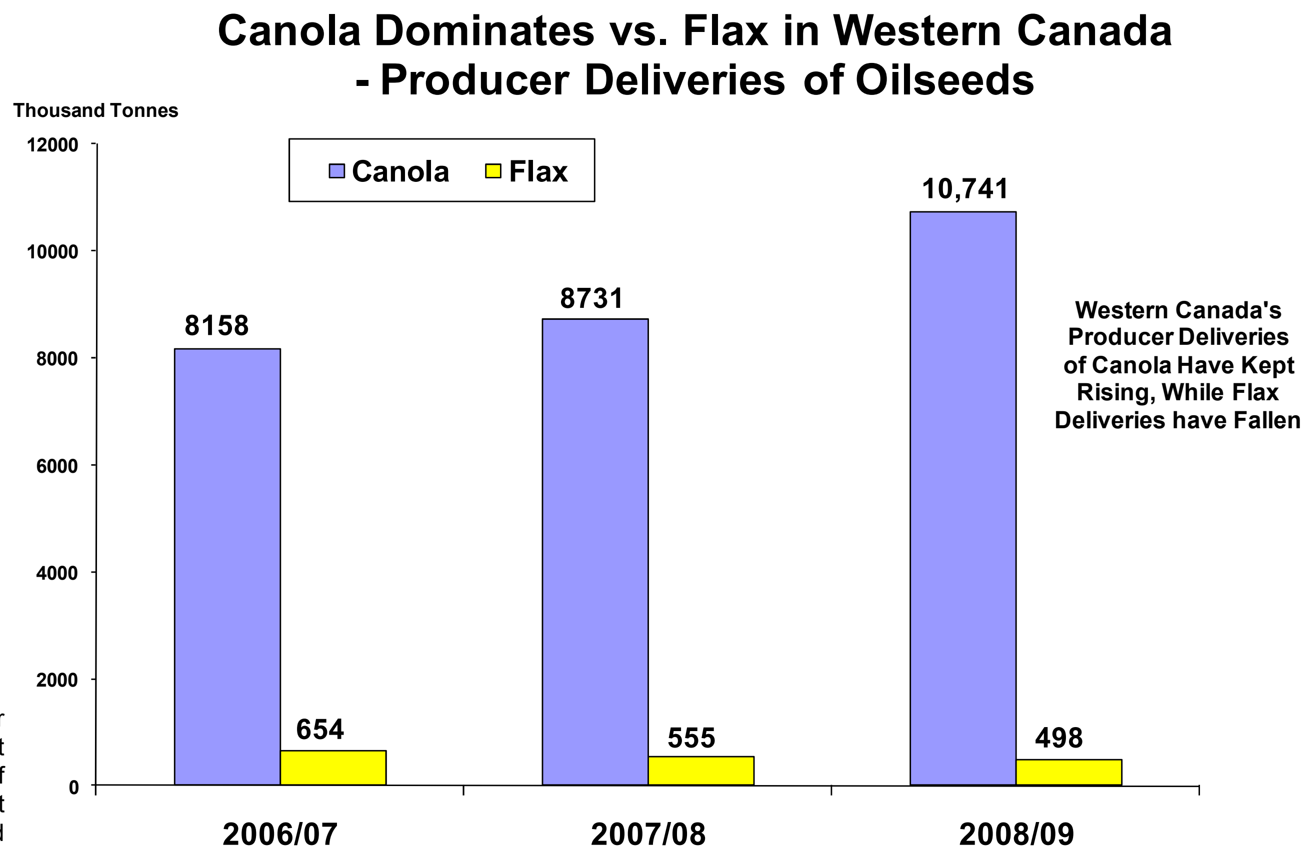
In addition to Asian markets, Canola annual exports to Mexico are consistent and markets in the Middle East are emerging rapidly.

Canada's exports of Canola oil in 2008/09 rose to over 1.7 million tonnes from 1.3 million tonnes on average over the period 2002/03 to 2006/07. Canola oil exports were broadly-based across several dozen countries, but with the USA taking the lion's share with over 67% of the total, and China with 26%. The USA accounted for almost all Canola meal exports from Canada.

Alberta Growers Have Switched to Canola.

Recent data show that the trend apparent above for western Canada also is true for Alberta – namely that flax growers have given up acreage in favour of Canola. As noted in the business case analysis (next section), the size of the supply base in flax and Canola and consistency of supply are important considerations for investors.

Exhibit 64



Data source: Cereals and Oilseeds Review June 2009

Alberta's flax farmers have a number of outlets for their crop. One of the highest rates of return in recent years reportedly has been the rapidly growing biofoods and naturopathic industry.

Flax Oil Production and Processing in Canada and Alberta

The technical potential for using flax oil (linseed oil) in SPF products was identified in the terms of reference for this report. Apparently, tests at the Calgary polymer plant have identified the magnitude of this potential, but the research results were not available for this report. Thus, the focus taken here is on the overall production of flax in western provinces, notably Manitoba and Alberta (Exhibit 65). The Exhibit confirms that flax producer shipments have been substantially higher historically in Manitoba than in Alberta – by a sizeable margin. Importantly, shipments from both provinces have declined substantially over the past thirty years. In volume output, flax is far lower than Canola volume.

Cultivation

The soils most suitable for flax, besides the alluvial kinds, typically are deep friable loams containing a large proportion of organic matter. Heavy clays are unsuitable, as are soils of a gravelly or dry sandy nature (source: Wikipedia). This limits the potential to grow the crop in some areas of Canada. On the other hand, farming flax requires few fertilizers or pesticides, and it has some significant biochemical properties, which give the crop a high appeal as an organic product (Exhibit 66). Flaxseed oil is richer than any other vegetable oil in essential fatty acids of the n-3 family (linoleic acid) and has a good reputation for treating a range of aliments, from heart disease to autoimmune disorders. Other sources of linoleic acid are rapeseed /Canola and soybean oils with approximately 10 %, whereas flaxseed oil contains up to 55 % of this fatty acid (source: Fediol).

Exhibit 65

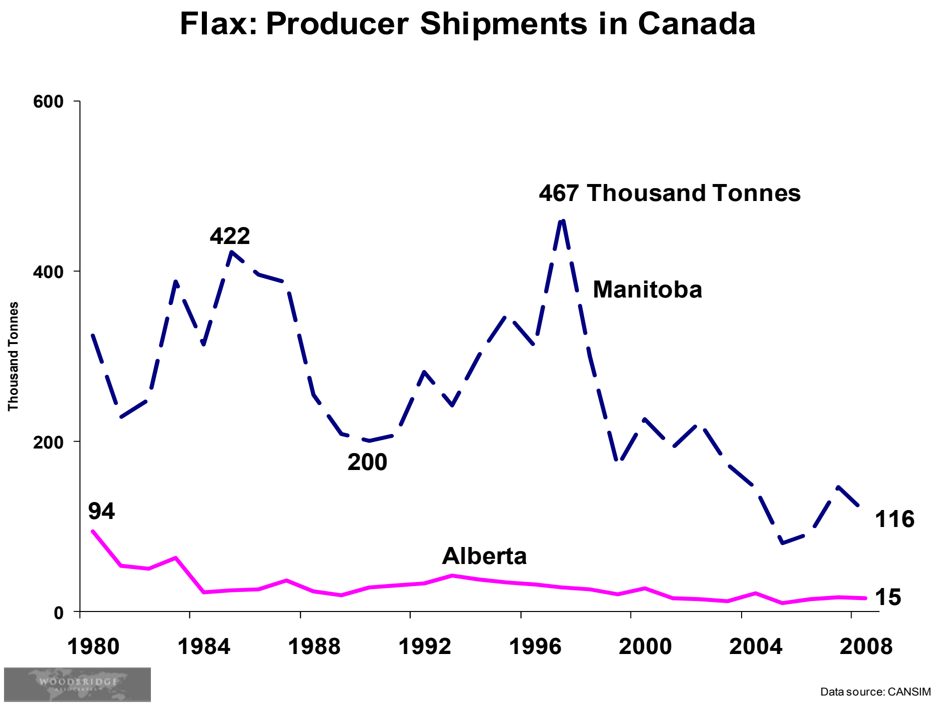


Exhibit 66

5. Conclusions:

Business Case
Evaluation Summary

Business Case: Evaluation Summary

The business case for Canola oil and/or flax (linseed) oil, potentially to be produced in Alberta, and used in the manufacturing of SPF insulation foams depends on several factors. The key ones include:

1. The existence of current users
2. The market prospects, and market-entry timing
3. The technical potential
4. Supply and supply-chain issues
5. Opportunity costs for growers
6. Competing products
7. Financial issues (costs, comparative prices and risk-discounted rates of return on capital [ROCE])

1.The Existence of Current Users

A well-established existing product in the North American SPF insulation market – *Icycene* – uses linseed as part of its formulation. Linseed has been chosen by the manufacturer, for its green product labeling, presumably on the basis of a number of factors including price, price consistency (vital for controlling costs and gaining market share) and availability. Another NOP SPF is *Walltite* which uses castor oil. In addition, *EnviroFoam* uses soybean oil. The existence of a successful and current user of linseed/flax oil is an endorsement and confirmation of the product's market potential.

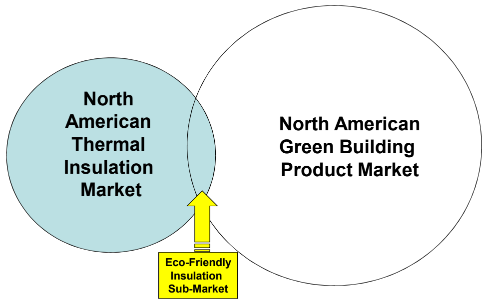
2. The Market Prospects

The extensive market analysis provided earlier in this report confirms the following key messages relating to the potential for using Canola/Flax (Linseed) oil in SPF insulation manufacturing.

- Spray-on foam (SPF) insulation has a 9% market share of the estimated US$8.5 Billion thermal insulation business in North America.
- SPF is increasing market share at a faster rate than most other products, with overall market demand growing at 5% to 6% per year.
- Natural Oil Polyols (NOP), including flax oil, are used in several existing 'green' SPF products.
- Soybeans, extensively grown in the U.S., are the source of NOPs used in the United States market.
- All NOP-based SPFs compete within the eco-friendly insulation sub-market (Exhibit 67).
- Closed cell and open cell foams are available, offering different attributes.
- Extensive 'green-washing' occurs in the green building products market.
- Not all 'green' insulation products, including some NOP-based brands, are truly 'green'.
- High energy prices in North America will increase the need for thermal insulation.
- Residential and non-residential sub-markets for thermal insulation are large and growing.
- SPFs provide the additional advantage of creating air-tightness in structures.

Exhibit 67

Canola Oil and Flax Oil Spray-On Foam (SPF) Insulation is a Niche Market Product … Part of the Eco-Friendly Sub-Market



Encouragingly, Rapid Expansion of the Green Building Products Market is Driving Demand for Eco-Friendly Thermal Insulation Products

The overall conclusion of the market evaluations supports very positively the business case for Canola oil and /or flax (linseed) oil us in spray-on foam insulation products. Potential investors will be encouraged by the strong overall growth in demand for thermal insulation as well as the market's shift towards more eco-friendly building products.

Business Case: Evaluation Summary (continued)

Market -Entry Timing

Although the overall market prospects are good for NOP SPFs, and could become spectacular if industry-led or regulated green product become widely adopted, another issue is market-entry timing. It rarely makes good business sense to launch new products, or significantly expand crops-under-acreage and processing capacity, when cyclical market are against the launch.

Exhibit 68 provides our assessment of one of the key drivers of North American thermal insulation demand – new housing in the United States. Other key indicators (such as the home improvement and non-residential markets) are discussed in the market assessment section of this report. With U.S. new housing starts forecast to average 515,000 units in 2009 (excluding mobile units) the overall outlook for demand recovery is indicated. It suggests a return to the 1.5 million annual starts level by 2013, and a return to longer term trend levels of 1.8 million starts by 2016. This outlook is constrained by affordability and the lack of ability to pay (i.e. consumer and building loan credit limitations), even though longer term household formation rates would indicate the *need* for housing at around 1.9 million units annually (source: Joint Center for Housing Studies: Harvard University). Moreover, in the very short term, the recovery may be more of a 'W-shape' (Exhibit 69) than a 'V-shape'.

Exhibit 68

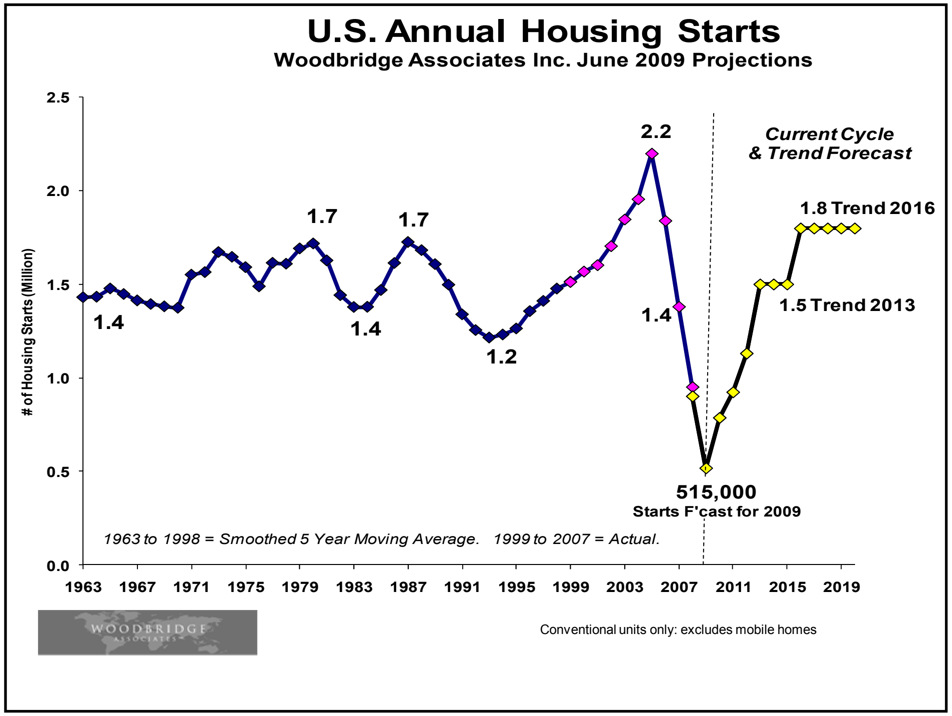
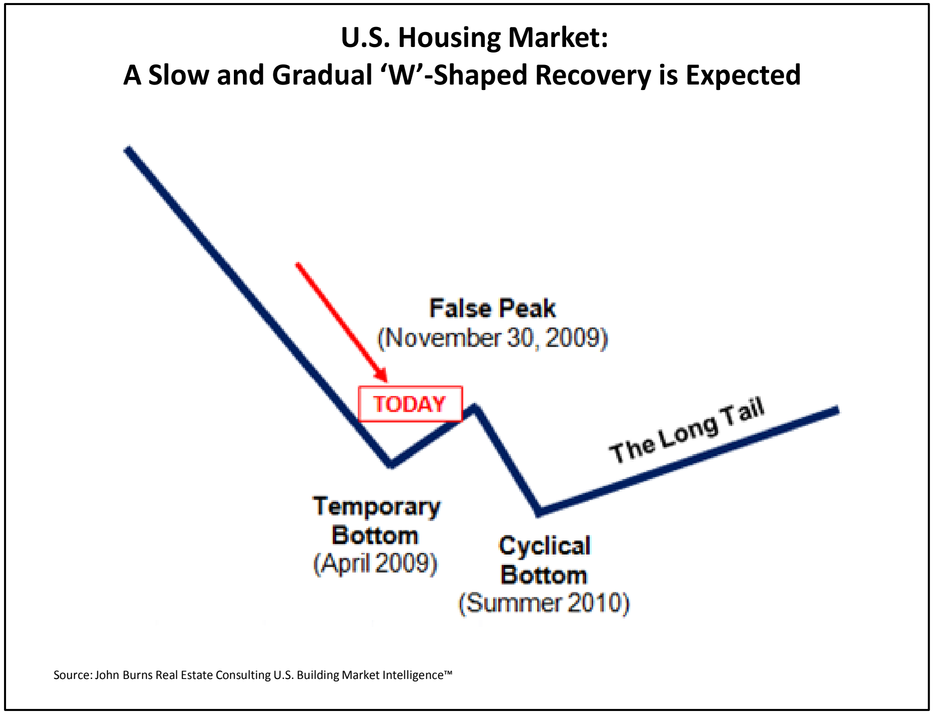


Exhibit 69



Business Case: Evaluation Summary (continued)

3. The Technical Potential

The technical potential refers to the volume percentage of Canola oil and/or flax (linseed) oil polymers that can be included in SPF products , notably those aimed at the eco-friendly market, thus displacing petroleum and other compounds the manufacturing of which involve the creation of high levels of GHGs. As noted earlier, the technical potential was not part of the scope of work for this report. It is noted that work at the Calgary polymers plants has yielded test results which can help indicate the technical potential of these specific NOPs. We assume that comparative technical results (i.e. comparisons vs. others NOPs) would be included in these research results.

4. Supply and Supply-Chain Issues

The global and Canadian oilseeds supply analysis provided as part of this report indicate a number of issues relating to NOP supply and the supply chain. These include the following:

- The 'base levels' of NOP crops grown in Alberta and competing jurisdictions
- The availability of processed oils capacity for the NOP SPF industry
- Crop prices
- Reliability of supply

Raw Materials Availability

Setting aside any quality and technical performance differences between the three oils – soybean, Canola and flax (linseed) – in spray polyurethane foam (SPF) production, there are a number of supply and supply-chain issues with regard to the reliability of supply of the oils and price differences between them.

The 'base level' of supply of keen interest to potential investors, as they would normally be inclined to locate any proposed processing plant close to raw materials supply. Correspondingly, as we will suggest later in this section in relation to flax oil supply in Alberta, investors would not normally be interested in locating a plant in areas which could be considered marginal supply areas or regions of supply unreliability. Thus, the concept of a 'base load' or critical mass of consistent and reliable supply becomes important.

In our evaluation (Exhibit 70) the base load of critical mass of Canola and flax growing in Alberta is fundamentally different, as the data presented in the previous section showed. Canola is in plentiful supply, while flax is comparatively less so –and there is a high opportunity cost for flaxseed for medicinal purposes and high end consumer products. While this would not necessarily preclude the potential for investors to construct a large scale flax oil polymers and processing plant in Alberta, it would be one of the factors likely to be taken into account in any due diligence evaluations by investors.

Exhibit 70

'Base Load' of Oilseeds Supply '000 Tonnes (2008/09 data)

Supply Region	Canola	Flax	Flax Deliveries as % of Canola
Alberta	3,909	15	minimal
Saskatchewan	4,467	382	9%
Manitoba	2,336	101	4%
Western Canada	**10,712**	**498**	**~5%**

Woodbridge Associates: Data from Cereals and Oilseed Review June 2009

Business Case: Evaluation Summary (continued)

Supply-Chain Issues

Another way of looking at the supply issue for all NOPs is to examine the supply chain leading down the processing steps to the final products.

This is not available for Canola or flaxseed oil, but a comparison with the well-developed soybean oil market in the United States provides an indication of the likely comparative importance of the thermal insulation market for NOPs such as Canola and flaxseed oil. Exhibit 71 provides this information for 2006.

48% of soybean oil consumption went into salad or cooking oil. A further 34% went into baking and frying fats. These would be, by implication, the major markets on which the oil producers would focus their sales efforts. It is relevant to note that, in the case of soybean oil, a significant volume – but only around 12% of total consumption –was accounted for by a wide variety of industrial end-uses.

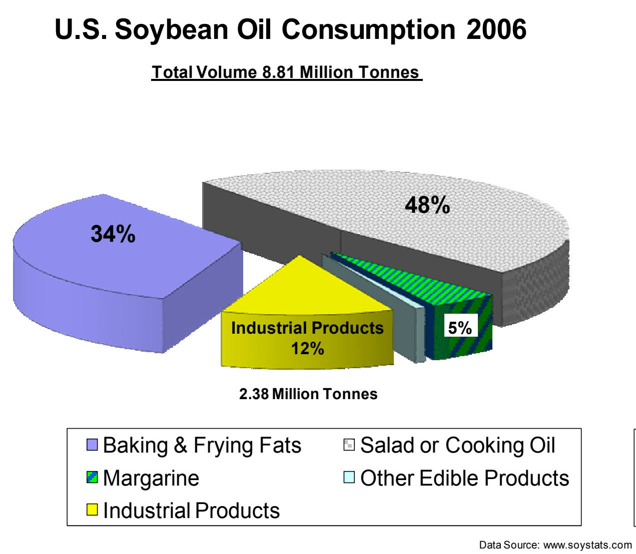
Details of the industrial market are provided on the right. Most of the soybean industrial uses comprise fatty acids soaps and feed. A small but growing volume is used for bio-fuels.

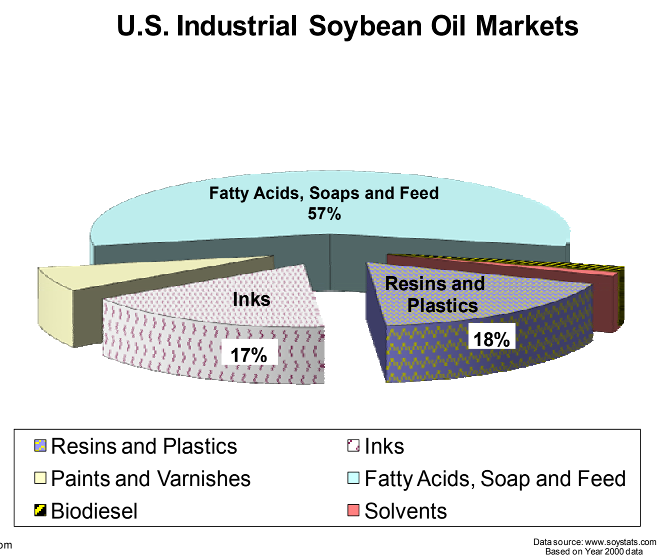
For Canola oil, a similar pattern is likely. For flax seed oil, the pattern would likely differ emphasizing the high-end consumer markets for this oil. Current SPF markets would be considered comparatively small by the oil producers. This could change, however, if the demand factors noted earlier come into play.

Exhibit 71

Benchmarked to the Consumption of Soybean Oil in Resins & Plastics in the U.S., the SPF Insulation Market for Canola Oil & Linseed Oil is Comparatively Small

Estimated U.S. Use of Soybean Oil in Resins and Plastics in 2006 was Around 430,000 Tonnes





Business Case: Evaluation Summary (continued)

5. Opportunity Costs for Growers

One of the commercial considerations for growers, processors and manufacturers of various NOP crops is the 'opportunity cost' involved, meaning the value of these crops and derivatives in their next highest value uses (e.g. Canola oil used/sold for bio-diesel vs. salad oil). Another opportunity cost is the 'lost' revenue from using the same land to produce a different crop (e.g. growing wheat vs. Canola or flax [a rotation crop]).

Bio-fuels: Biodiesel and Ethanol

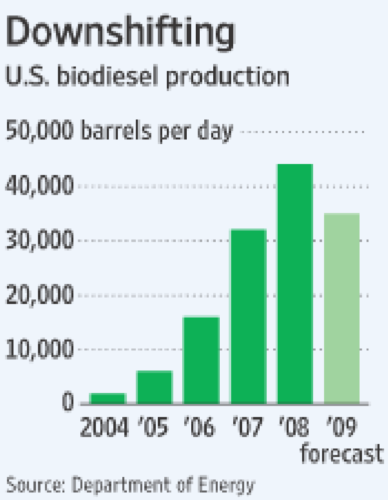
Biodiesel can be made from soybean oil or Canola oil plus methanol or ethanol. While this product is common in many countries, notably Brazil (soybean oil based fuels), the demand in North America has yet to grow to the point where biodiesel and ethanol significantly will impact the crop base load. Even so, this potential has been heralded. The U.S. EPA plans to blend cellulosic bio-fuels into the U.S. fuel supply in 2010. Congress has set targets to increase bio-fuel's share of the liquid-fuel mix from 5% to roughly 16% by 2022. In the short term, however, with the global recession and sharp decline from peak oil prices, bio-fuel demand has waned (Exhibit 72)

Highly productive farmland has become in short supply. Product prices are rising in many cases. For growers of all crops, their 'opportunity cost (i.e. the next highest alternative crop use of their land) is likely to continue rising on a trend basis. Unless relative prices shift upwards, the surge in bio-fuels demand and prices and rising food shortages will place a higher priority on growing crops for bio-fuels and conventional food versus cultivating NOP crops for the SPF insulation market.

Canadian SPF producers, such as *Icynene,* who use linseed oil as their preferred NOP, face demand and price competition for the crop from a rising number of bio-foods producers. This presents a possible opportunity for Alberta farmers. Responding to higher prices for flaxseed, they could sharply increase the acreage under flax-for-seed in coming decades.

Biodiesel = soybean oil or Canola oil plus methanol or ethanol

Exhibit 72



Source: Wall Street Journal

6. Competing Products

Competing Natural Oil Polymer (NOP) feedstocks to Canola and flax include castor oil and others. Much of the substitution between these NOPs will depend on factors such as costs and technical performance.

7. Financial Issues (Costs, Product Prices and Investors' Risk-Discounted Rates of Return on Capital [ROCE])

These are discussed in the next several pages –and are critical to the business case for the two NOP products under consideration.

From the growers' perspective, oil is not the only consideration. For example, one of the financial limitations applying only to flax oil (linseed oil) is that the crop has limitations in the animal feed market due to its amino acid make-up, the expeller meal is a valuable protein livestock feed (particularly for ruminants) and has a crude protein level of 38%. Whilst this does not compare directly with the higher protein feeds such as soybean meal, it is comparable with more direct competitors such as Canola (Source: Fediol).

Our overall assessment with regard to flax oil use in SPFs is that it seems doubtful, on the basis of these statistics and trends, that the outlook for flax and flax oil production in Canada and Alberta is very supportive of the business case for using this product for large scale SPF insulation production – unless a new set of producer and pricing economics becomes apparent, which could happen but is not readily evident today.

It seems doubtful, on the basis of these statistics and trends, that the outlook for flax and flax oil production in Canada and Alberta is very supportive of the business case for using this product for large scale SPF insulation production – unless a new set of producer and pricing economics becomes apparent.

Business Case: Evaluation Summary (continued)

Financial Issue A. Raw Materials Availability and Costs

Price Differences Between the Oils

Provincial and national level data on oil prices is not available but, for business case analysis, oilseed prices can be used as a proxy. Adjustments have to be made to oil yields from crushing and other factors to arrive at an accurate assessment of the cost competitiveness of each oil. Manufacturers' pricing policies for industrial grades as distinct from food grades also are relevant.

Generally, the movement of Canadian prices for the three oilseed moves roughly in parallel: however, there are significant price differences at specific points of time and in longer term trends.

The price relationships for the past roughly seventeen years are shown in Exhibit 73.

Up until the early 2000s, Canola prices trended above those for soybeans and flaxseed. At least part of this comparative price strength most likely can be attributed to the strong growth which occurred in Canola (rapeseed) growing as well as the expansion and strong marketing and branding by Canada's Canola oil industry – leading to relatively rapid rates of growth in consumer demand.

The rising importance of various feedstocks required by North America's bio-fuel industry exerted a heavy influence on oilseed demand and prices at the beginning of the 2000s.

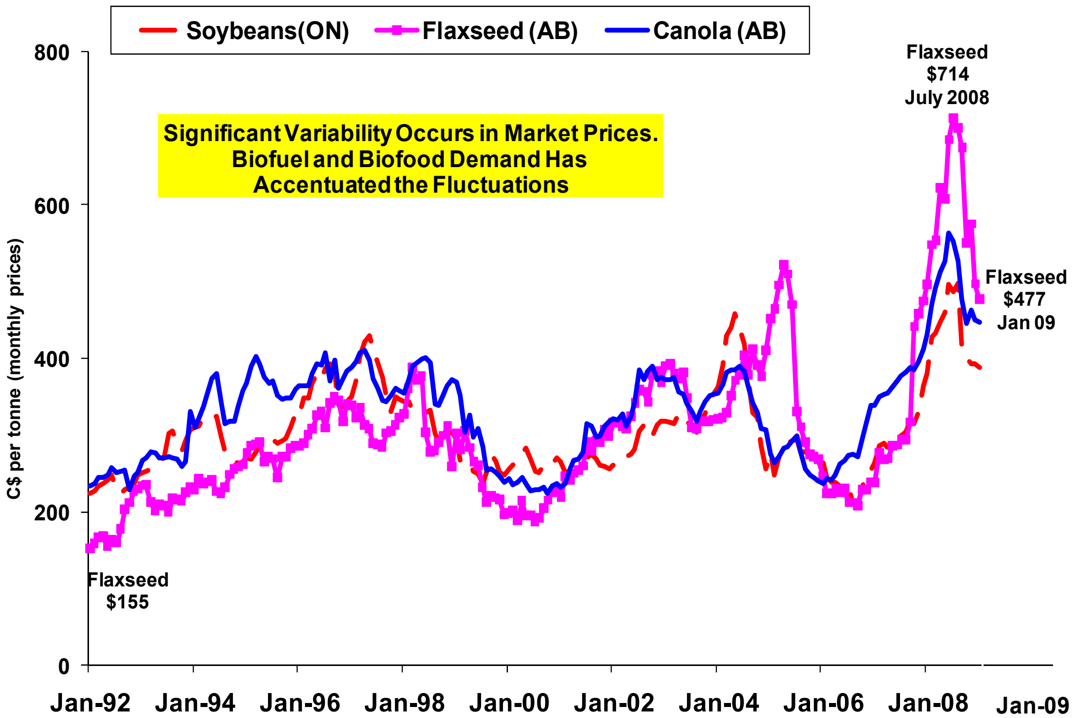
More recently, the recognition of health food and nutritional benefits of flax (as a flour and oil) have helped push flaxseed prices much higher than both Canola seed and soybean.

In fact, by their recent peak prices of C$414/tonne reached in July 2008, flaxseed prices rose by over 3.5 times their 1992 prices.

There also has been significant volatility in each of the prices for the three oilseeds. In the case of flaxseed, prices declined very sharply – by over one-third – from January 2009 to its summer 2008 highs.

Although not as sharply defined, it is evident that there is significant price volatility also in Canola seed and soybeans. These are factors that SPF manufacturers typically would take into consideration when designing their products and choosing their natural oil polyol (NOP) blends.

Canada: Oilseeds Price Trends — Exhibit 73



Data source: CANSIM 002-0043

Business Case: Evaluation Summary (continued)

Financial Issue A. Raw Materials Availability and Cost (continued)

Price Differences Between the Oils

Exhibit 74 illustrates in more detail the movement of flaxseed prices compared with soybean prices. We use soybean prices as the benchmark because of the dominance of soybeans in the US oilseeds industry – and because bio-based SPF manufacturers, such as EnviroFoam, use soybean oil as their principal NOP.

In the 1990s, flaxseed (and, by implication, flax oil) prices generally remained at a significant discount to soybean. In some case, this dropped to a 25% discount in favour of flaxseed. More recently, as the nutritional value of flax has become more widely recognized, flaxseed prices typically have stood at a significant premium to soybean (e.g. 20% to 64% higher).

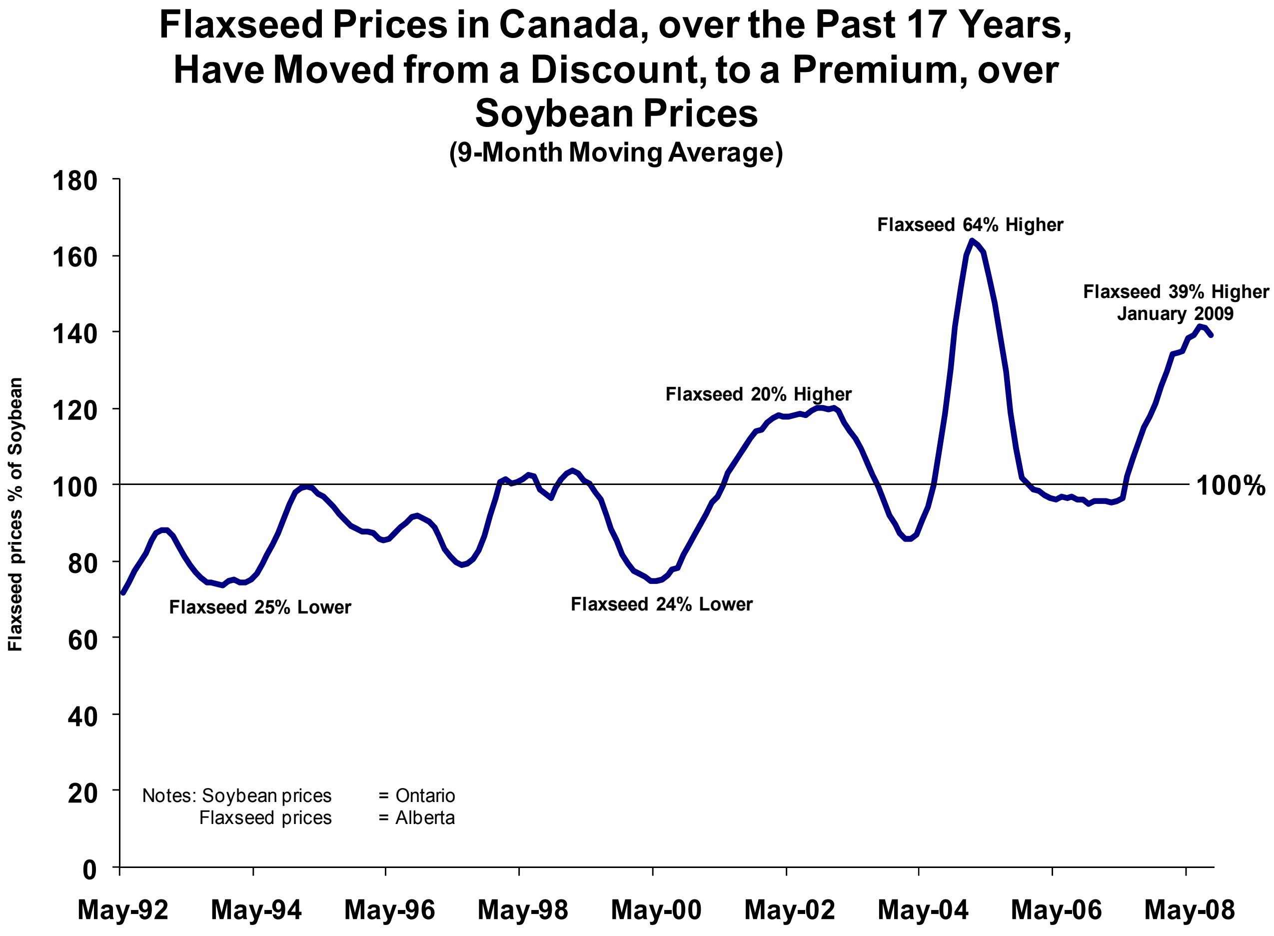
Impact of Demand from Other Sectors on NOP Prices

Most flax produced in the USA and Canada consists of seed flax types and is used for the production of linseed oil or flaxseeds for human nutrition.

Flax seeds contain high levels of lignans and Omega-3 fatty acids. Lignans may benefit the heart and possess anti-cancer properties. Studies performed on mice reportedly found reduced growth in specific types of tumors. Initial studies suggest that flaxseed taken in the diet may benefit individuals with certain types of cancers. Flax may also lessen the severity of diabetes by stabilizing blood-sugar levels (source: Wikipedia).

Bio-food demand for flaxseeds, flax meal and flax oil have contributed to the higher price trends (compared with soybeans and Canola) in recent years. Higher prices are a function of growing demand and limited supply and, responding to these higher prices, supply could change if the differentials remain high.

Exhibit 74



Data source: CANSIM

Business Case: Evaluation Summary (continued)

Financial Issue A. Raw Materials Availability and Cost (continued)

<u>Price Differences Between the Oils</u>

As already noted, oilseed prices are only a proxy for the actual prices paid by SPF producers for the industrial (NOP) oils they purchase. Even so, where price fluctuations and differential relationships between oilseeds prices become significant, extracted-oil prices will tend to move in the same general direction.

History and recent trends are useful as indicators of potential impacts on NOP oil prices. Over the past approximately seventeen years (Exhibit 75 shows a 9-month moving average), Canola oilseed prices have been 10% higher on average than soybean prices.

There have been times when Canola prices have stood at a much higher premium to soybeans than these average data might suggest. The Exhibit shows that, over this period, there have been four significant 'spikes' in Canola seed prices above soybean prices. These spikes have involved Canola price premiums over soybean ranging from 23% to 34%.

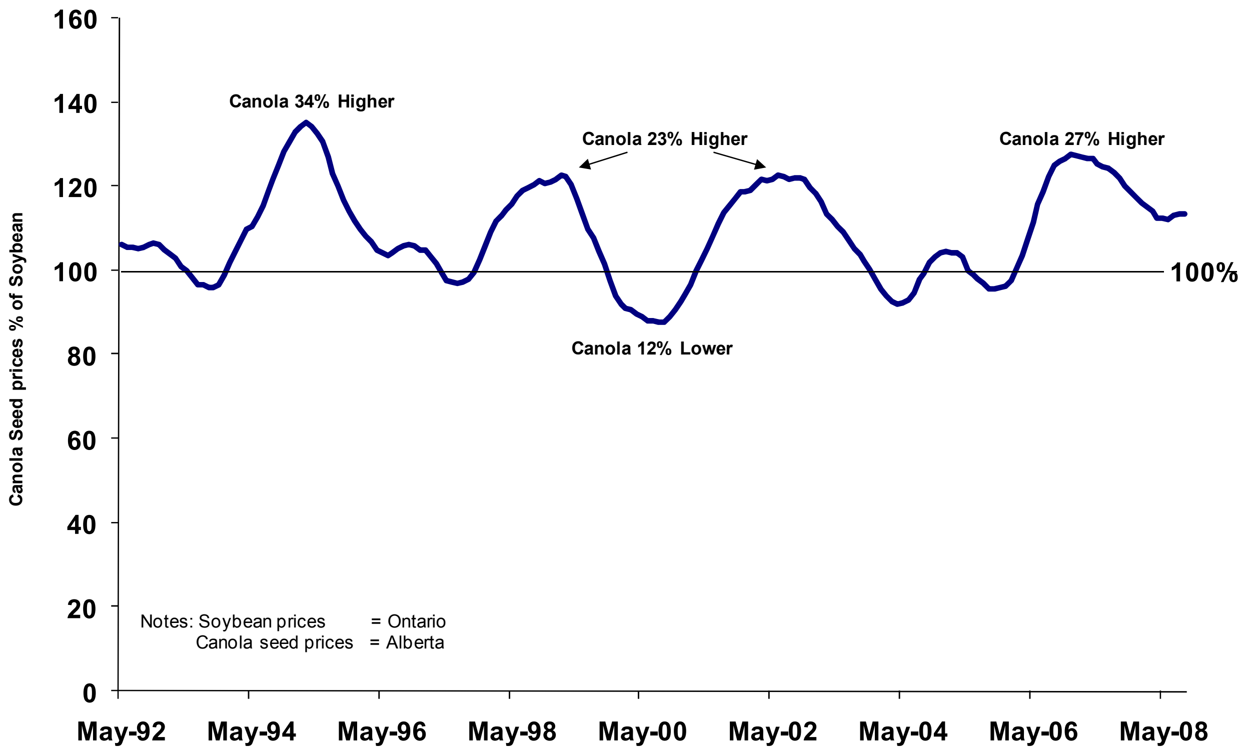
Infrequently, in the past, Canola seed prices have dropped to a significant discount to soybean prices (e.g. mid to late 2000, when a 12% discount was experienced).

<u>Oil Price Impact on Cost Structure of NOP Users</u>

Without more detailed information on the cost structure of 'A' and 'B' materials used in SPF, it is difficult to know what overall impact these NOP price differentials have over time on the manufacturers' cost competitiveness versus other manufacturers. There are also quality and performance differences to take into account. Even so, NOP raw material price trends, as noted above, potentially can become significant factors.

Exhibit 75

Over the Past 17 Years, Canola Seed Prices in Canada Have Averaged 10% Higher than Soybean Prices
(9-Month Moving Average)



Data source: CANSIM

Business Case: Evaluation Summary (continued)

Financial Issue B. Product Revenues

With federal, state and some local government financial and non-financial incentives to upgrade thermal insulation standards throughout North America, the general business case for 'more insulation' in building structures is evident. However, these incentives do not differentiate between 'green' and non-green' thermal insulation products. So, there is not particular incentive for the consumer to use one over the other. Correspondingly, there is at present no additional revenue that NOP-based SPF manufacturers can pursue compared with conventional GHG creating products.

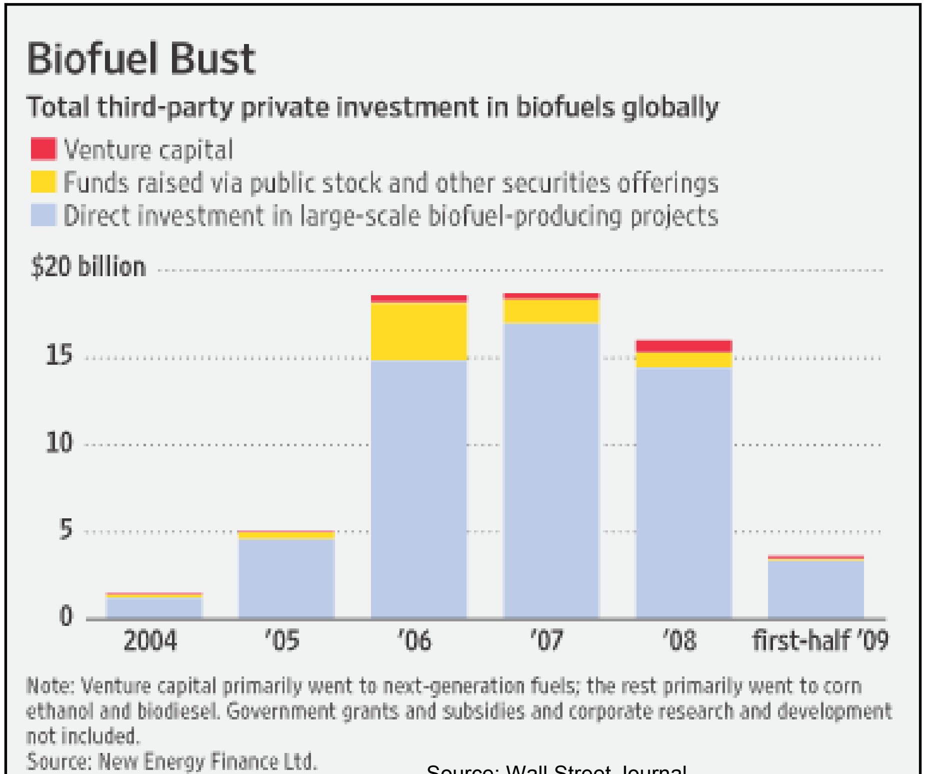
Alberta's primacy in Canola growing and Canola oil production positions the province well for attracting potential investors in a future polymers and processing plant supplying the NOP SPF market in North America – and offshore.

Financial Issue C. Return on Investment and Investor Risk

The large and emerging green building products market in North America holds considerable promise, and financial rewards, for pioneering manufacturers of NOP-based SPF insulation. But demand is cyclical and, within the overall positive trend for these products, numerous risks lurk.

This already is evident in the burgeoning bio-fuels industry (Exhibit 76) which provides an estimate of the dramatic decline in 3rd party private investment in bio-fuels since the decline of global oil peak prices. Direct investment has plumetted recently.

Exhibit 76



Source: Wall Street Journal

Investors are wary of committing significant investment funds to new projects of the type discussed in this report. Even so, with a strong business case, such investments could proceed – especially if it helps strategically position pioneering firms advantageously.

Our conclusion is that Alberta's primacy in Canola growing and Canola oil production positions the province well for attracting potential investors in a future polymers and processing plant supplying the NOP SPF market in North America – and offshore.

We also conclude that, all other things being equal, an investor probably would choose Saskatchewan over Alberta for the location of a flax/linseed oil processing plant.

All other things being equal, an investor probably would choose Saskatchewan over Alberta for the location of a flax/linseed oil processing plant

Woodbridge Associates Inc.
www.woodbridgeassociates.com