

# Challenges Facing Small and Medium Scale Biodiesel Production Facilities in Western Canada

*Eshetu Beshada, Doug Small and Dennis  
Hodgkinson*

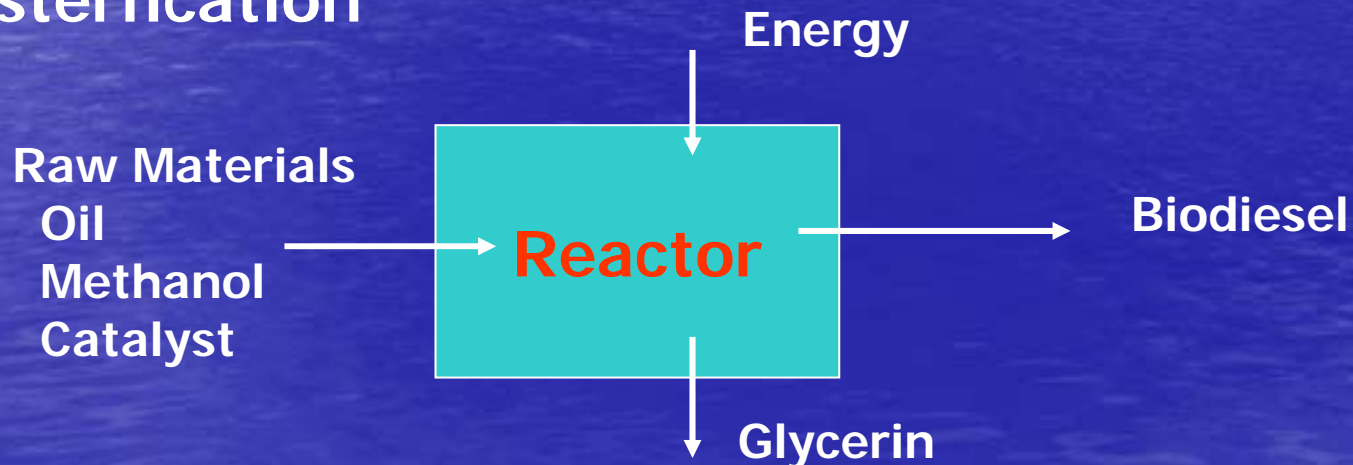
DGH Engineering Ltd., 12 Aviation BLVD., St  
Andrews, Manitoba, R1A 3N5



# What is Biodiesel?

- A mono-alkyl ester produced from vegetable oil or animal fat.
- Produced by a process called transesterification.
- A substitute for diesel fuel – (must meet ASTM D 6751)

## Transesterification



# Why Biodiesel?



- Reduce greenhouse emission
- Search for alternative to petroleum – fuel security
- Value-added to animal fat, yellow grease and off-grade (heated) oil seeds.
- Income diversification for farmers

# Biodiesel Feed Quality

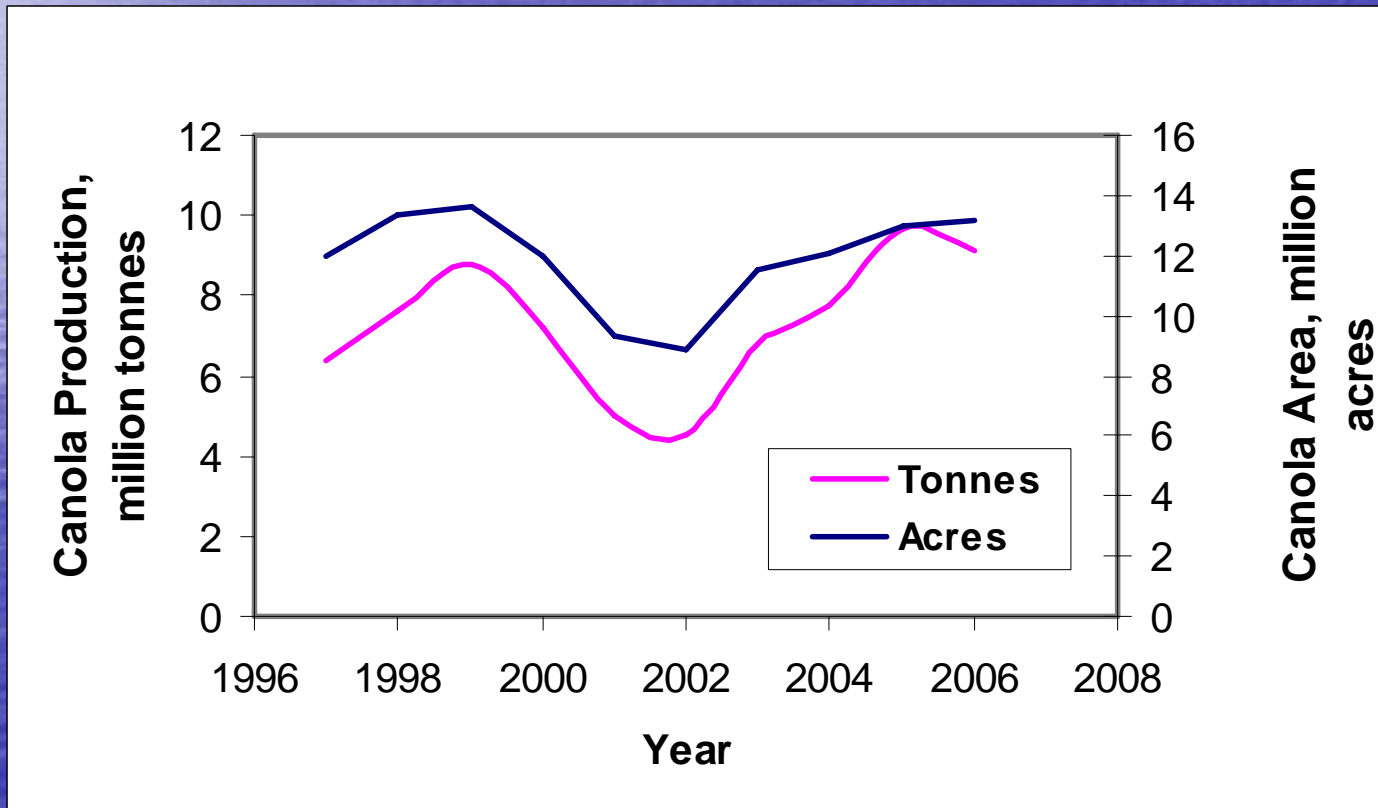


- Free Fatty Acid (FFA) content is the most important criteria for selecting feedstock.

<b>Feedstock</b>	<b>% FFA Content</b>
Refined Vegetable oil	< 0.05
Soy oil – crude	0.3 – 0.7
Canola Oil – crude	0.1 – 0.5
Restaurant oil	2 – 7
Animal fat	5 - 30
Trap grease	40 - 100

# Feedstock Availability

- Canola area and production in western Canada. 10% of this resource produces 280 – 350 million L/year of biodiesel.



Source: Field Crop Reporting Series – Statistics Canada

# Feedstock Availability



The table below outlines the approximate availability of low grade (high FFA) feedstock in western Canada.

<b>Feedstock</b>	<b>tonnes</b>
<b>Yellow Grease</b>	<b>&gt;25,000</b>
<b>Animal Fat</b>	<b>&gt;150,000</b>
<b>Off-grade Canola</b>	<b>&gt;400,000 (5% damaged)</b>

# Challenges in Biodiesel Production



- High cost of production compared to petroleum.
  - 70 – 80% of cost is feedstock
- Lack of technology ready for small and medium size plant installation.

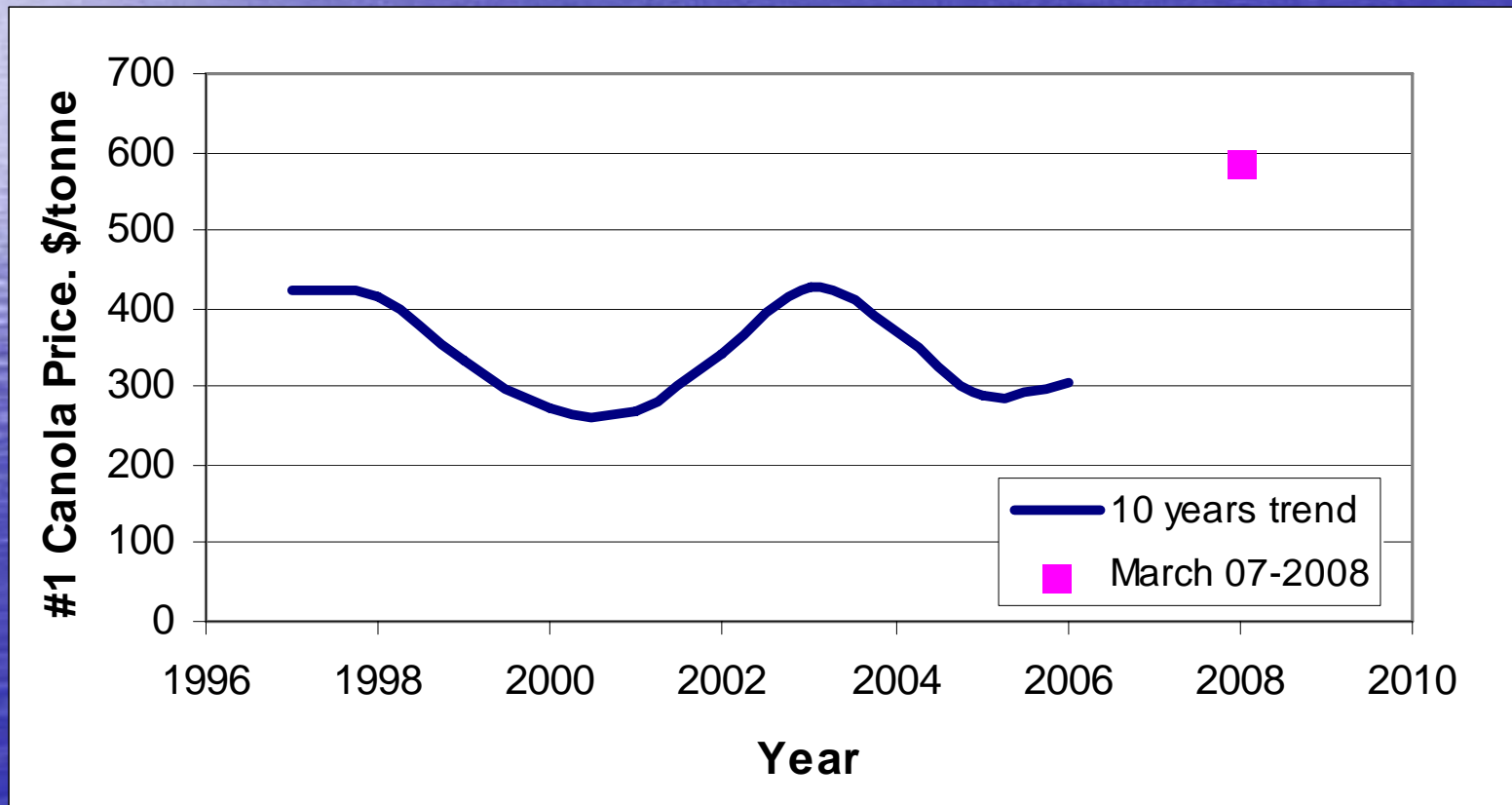
# Reducing Biodiesel Production Cost



- The production cost can be reduced by utilizing low grade (high FFA) feedstock.

# Canola Price

- The price of canola fluctuates as shown below. The average price was about \$350/tonne over the past 10 years. The price in Winnipeg on 07 March, 2008 was \$585/tonne.



# Low Grade Feedstock Prices



The table below outlines the approximate cost of high FFA Feedstock.

<b>Feedstock</b>	<b>Price \$/tonne</b>
<b>Yellow Grease</b>	<b>\$ 380 - 470</b>
<b>Animal Fat</b>	<b>\$ 380 - 480</b>
<b>Off-grade Canola</b>	<b>Depends % damaged</b>

# Low grade canola discount



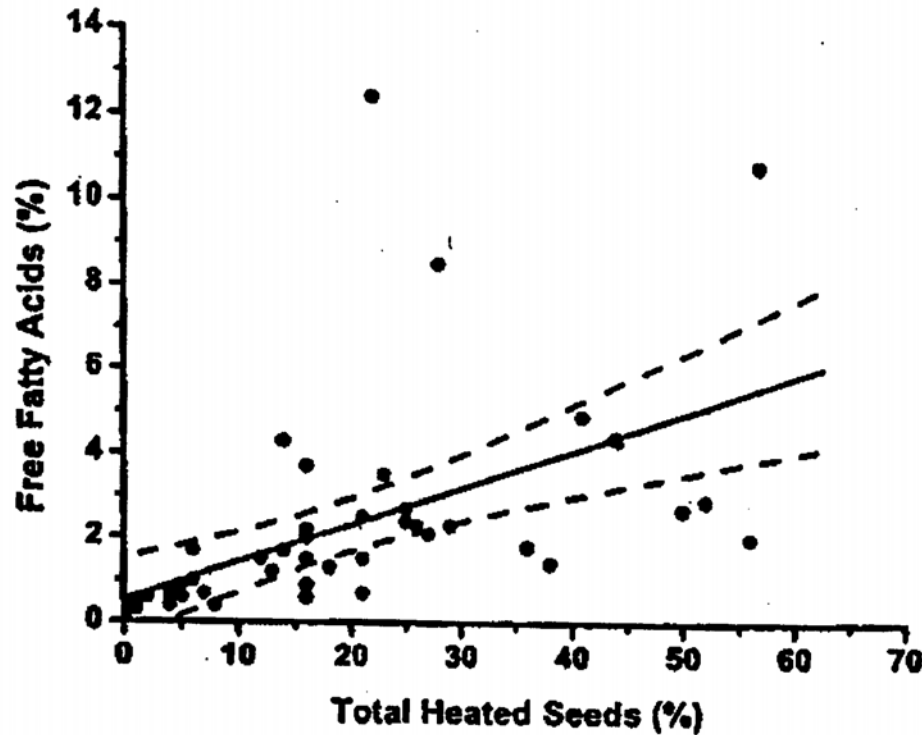
The table below outlines the approximate discounts given for heated canola

<b>% Heat Damage</b>	<b>*Discount, \$/tonne</b>
<b>0.6 – 2.0</b>	<b>\$ 90.00</b>
<b>2.1 – 5.0</b>	<b>\$100.00</b>
<b>5.1 – 10.0</b>	<b>\$130.00</b>
<b>10.1 – 15.0</b>	<b>\$150.00</b>

**Sources oil industry in Winnipeg.**

\* The discount varies from 20 to 50% of the actual price of #1 Canola. During high canola price the discount will be lower and negotiable.

# FFA of Heated Canola

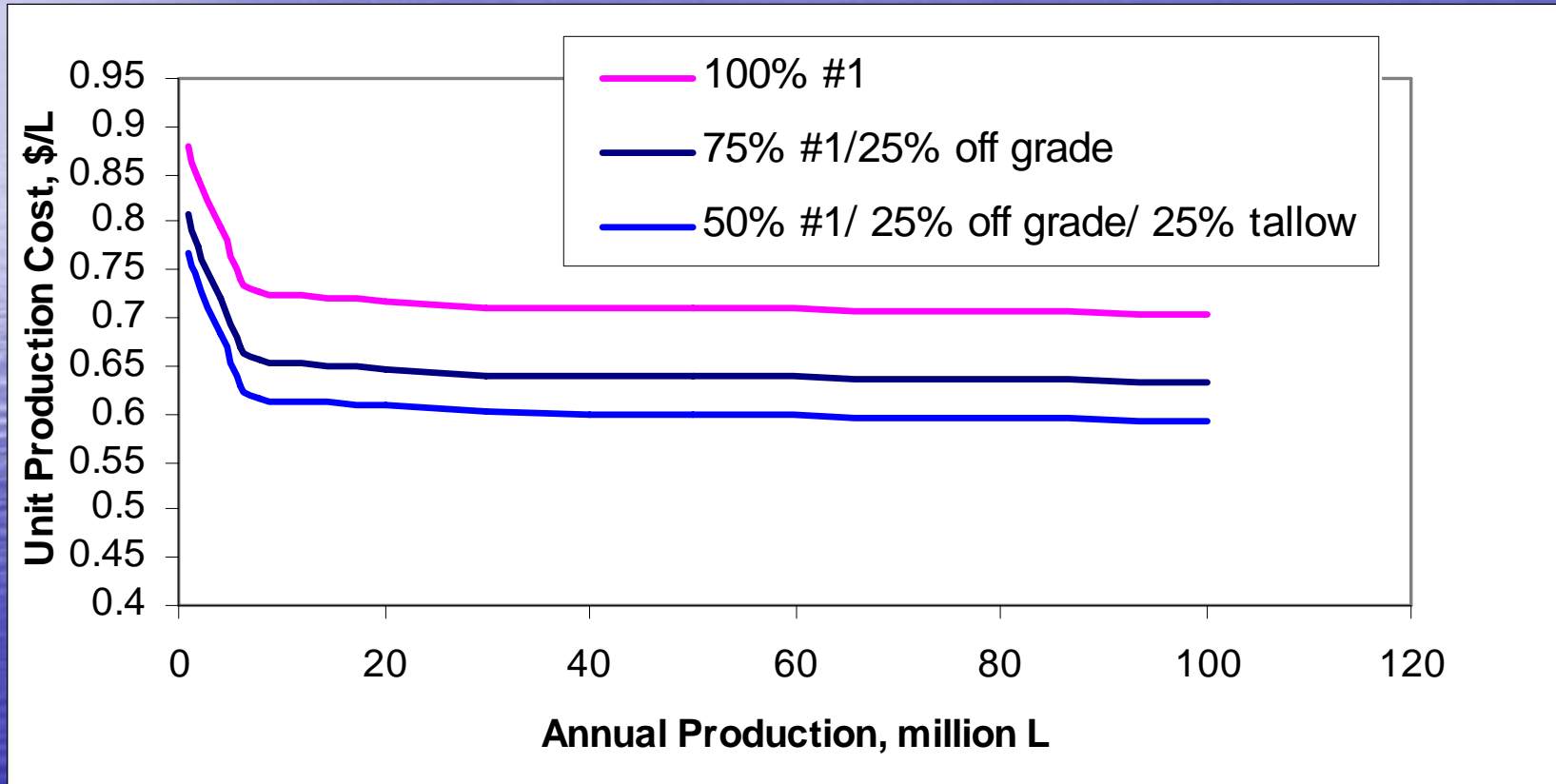


Relationship between free fatty acids in oil and heated canola seeds as determined by the Canadian Grain Grading System. Samples from 1977 and 1978.  
Grains & Oilseeds, 5th edition, J. Daun

# Long Term Production Cost



Using low grade (high FFA) feedstock decreases the biodiesel production cost as shown below.

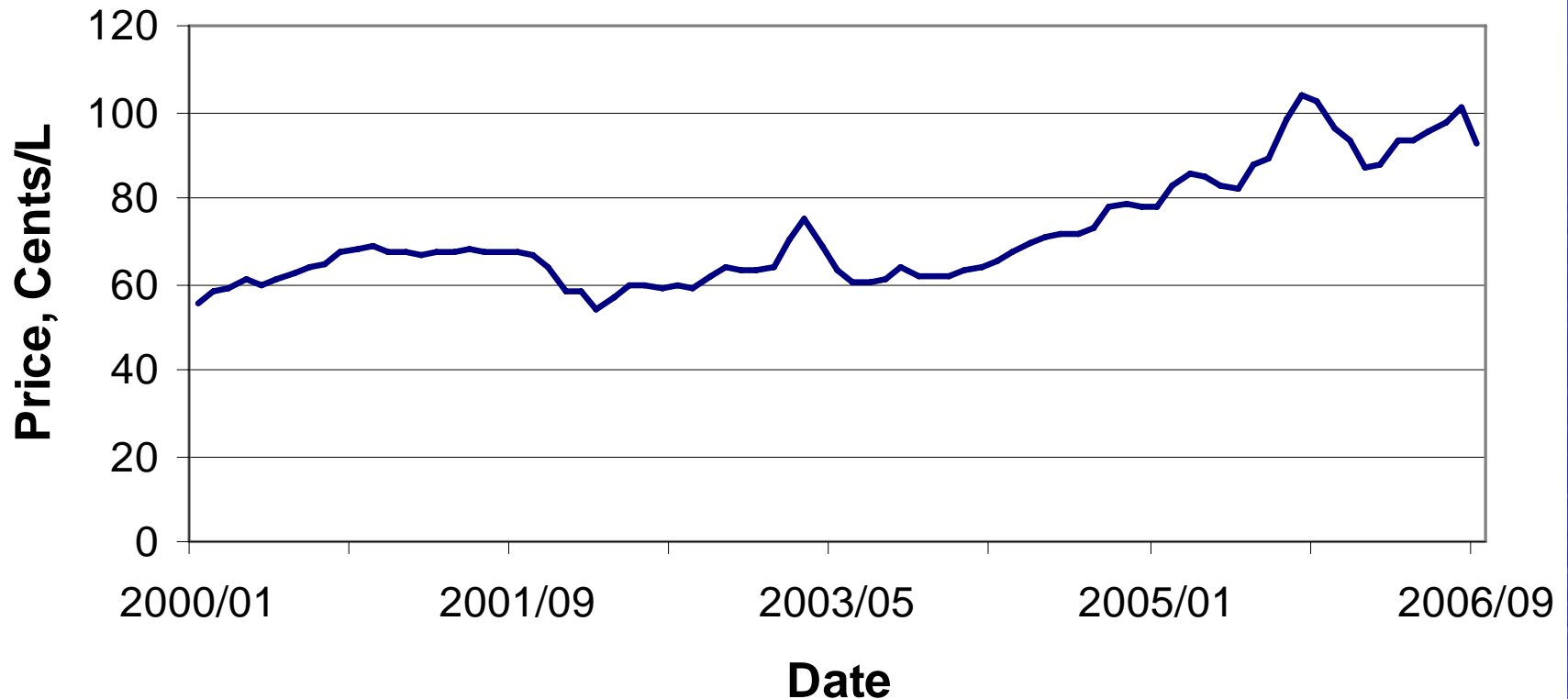


Assumed prices: canola oil \$860/tonne (\$300/tonne #1 Canola), Off-grade Canola \$180/tonne and Tallow \$480/tonne.

# Petroleum diesel Price



Diesel fuel price in Winnipeg during the last six years.  
Data obtained from Stats Canada. Price on march 07, 2008  
was 112.9 cents/L.



# Process Technology



- It is difficult to find technology providers
  - dealing with small scale production (< 10 million Litres per year)
  - No readily available expertise that deals with high FFA feedstock for small scale plants.
- DGH Engineering identified an experienced supplier
  - Process feedstock with a FFA content of 15%.
  - Efficient methanol recovery without distillation tower.
  - Integration of oil seed crushing.

# Process Technology



- Advantage of integrating oil seed crushing:
  - Necessary to crush off-grade canola
  - Generate extra revenue through sales of feed meal
  - Provide market for glycerin in feed meal.

# Required Capital Cost



Estimated capital cost to construct 10 million L/year plant.

<b>Items</b>	<b>Typical American Estimate*</b>	<b>DGH - Engineering</b>
<b>Infrastructure</b>	<b>\$ 390,000</b>	<b>\$ 330,000</b>
<b>Process Equipment &amp; Installation</b>	<b>\$ 1,600,000</b>	<b>\$ 1,300,000</b>
<b>Storage Tanks &amp; accessories Installed</b>	<b>\$ 500,000</b>	<b>\$ 500,000</b>
<b>Electrical and Plumbing</b>	<b>\$ 475,000</b>	<b>\$ 210,000</b>
<b>Engineering and Project Mang't</b>	<b>\$ 125,000</b>	<b>\$ 125,000</b>
<b>Lab and ancillary equipment</b>	<b>\$ 290,000</b>	<b>\$ 125,000</b>
<b>Total</b>	<b>\$ 3,380,000</b>	<b>\$ 2,590,000</b>

\* Without crushing, feed pretreatment and methanol recovery system

# Process Technology



- DGH Engineering provides
  - Full scale feasibility study,
  - Environmental Assessment,
  - Business plan preparation and
  - All engineering services required to install a biodiesel Plant.
- Currently DGH Engineering and its partner are installing a 10 million litres per year capacity biodiesel plant for Eastman Bio-Fuels Ltd. in Manitoba.