# Feasibility Study for Commercial Production of Biodiesel in the Treasure Valley of Idaho

Contract No. CON 00642

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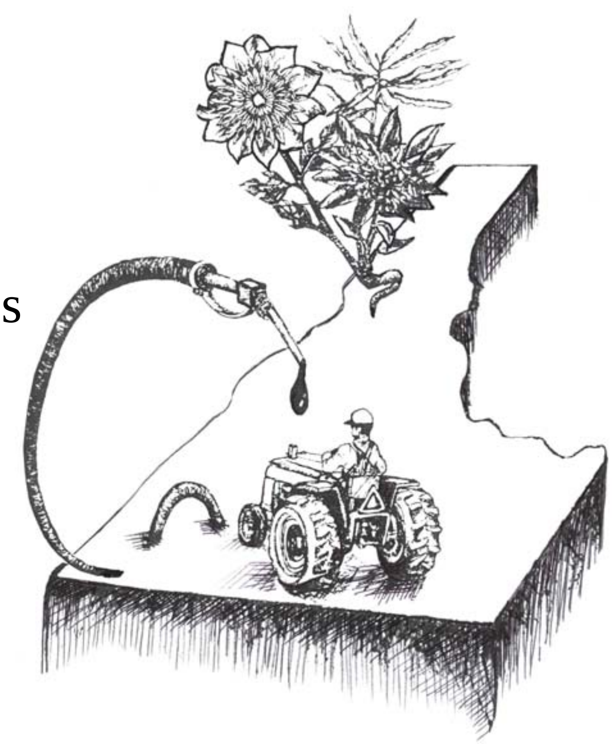

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# I. EXECUTIVE SUMMARY

This study investigates the feasibility of a commercial biodiesel production plant in the Treasure Valley using local resources. "The Treasure Valley" is defined as nine counties: Ada, Boise, Canyon, Elmore, Gem, Payette, Owyhee and Washington counties of Idaho and Malheur County in Oregon (Figure 1). In 2001 the total population of the study area was estimated at 577,000 with a growth rate of about 2.55% per year. About 42% of Idaho's population resides within the study area while only 0.9% of Oregon's population is within the study area. The study area comprises 17 million acres, of which 6.5% or 1.1 million acres are mostly irrigated cropland.

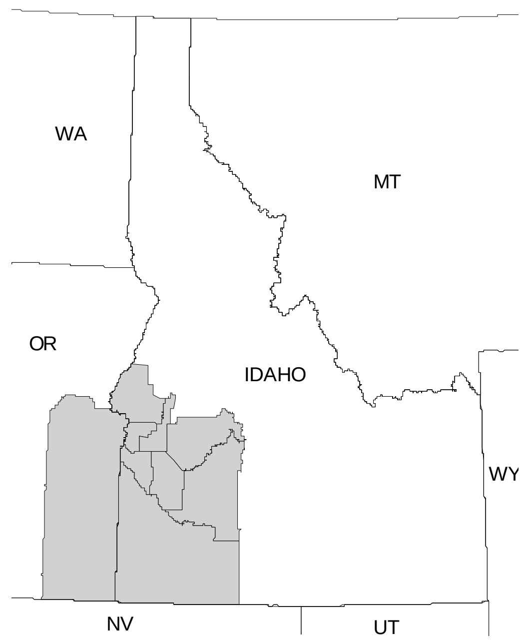


**Figure 1 – Study Area**

The purpose of the study is to identify potential local sources of raw materials for a biodiesel facility, suggest possible sites, and identify marketing options for the fuel produced and for all the potential by-products. In addition, the study identifies economic and environmental barriers affecting the location of a successful plant for the production of biodiesel.

There are several feedstocks and potential feedstocks from which to produce biodiesel in the Treasure Valley. These include yellow grease, tallow, oils from food processing facilities, and oil from oil seed crops. Agriculture Order 02.06.13 limits the consideration of Canola and rapeseed as a viable feedstock in much of the study area. In those areas which can grow canola and rapeseed, the winter varieties would be best to ensure the flowers develop before the high temperature of late summer.

Oil seed crops have been grown in the area on a limited basis. Soybean varieties are being developed to accommodate the local climatic conditions, however, they are not a viable commercial source of oil at the present time. Safflower and sunflower are grown in the arid west from the central plains to California. Yield for all oil seed is related to available moisture. The response is about 100 to 150 pounds per acre per inch of available moisture for safflower and sunflowers respectively. The local experience with sunflowers indicates that birds will greatly reduce yields. Safflower will grow as both a dry land and irrigated crop with returns equal to or greater than that for small grains. However, there is a lack of farm management information in the Treasure Valley to optimize the incorporation of oil seed crops in the rotation.

Resources exist to develop a small to medium sized biodiesel facility and a corresponding market in the Treasure Valley. Site location will be influenced by plant size. Mid-sized to large plants would have to locate near existing rail lines. Small plants would use highways for both shipping in raw materials and shipping out products. Considering 50 percent of the available yellow grease as the only feedstock, a 500,000-gallon biodiesel plant could be supported. If both 50 percent of the yellow grease and tallow were feedstocks, then the capacity would increase to 4.25 million gallons.

Two scenarios were developed to examine the feasibility of using oil seeds grown in the area as feedstocks. Oil seed crops would have to compete with small grains in the rotation to be economically viable. If a conservative estimate of oil seed in the crop rotation once in twelve years were used, an estimated 12 million gallons of oil would be available for biodiesel production. If a more optimistic estimate were used, such as one in eight years, then 18 million gallons of vegetable oil would be available.

Thus, the potential exists in the Treasure Valley for a mixed feedstock biodiesel plant with an annual capacity between 0.5 and 22 million gallons. The Treasure Valley market for a B2 (2%) biodiesel blend is about 3 million gallons per year. A B20 blend would require about 30 million gallons per year.

The cost of biodiesel production is dependent on the plant capacity and feedstock selection. It is currently estimated to be between $1.38 and $3.41 per gallon. The biodiesel production byproducts would be glycerin from all feedstocks and oil seed meal from oil seeds. Glycerin could be problematic for biodiesel plants in the Treasure Valley even though it is used in many products and processes. It is costly to purify and impure glycerin has little value. In contrast, oil seed meal could be a component in the rations of dairy and beef cattle in the Valley of which there are sufficient number to utilize both byproducts.

# II. INTRODUCTION

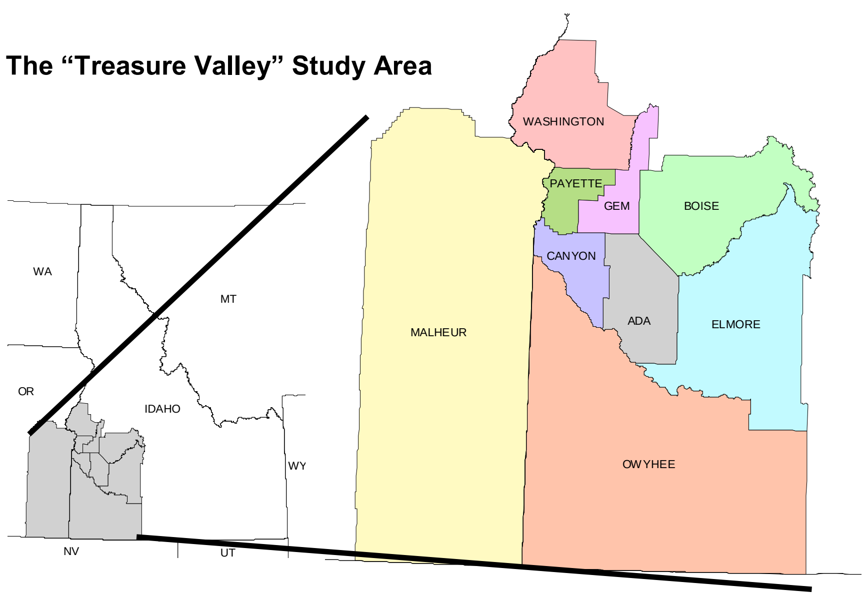
The Idaho Energy Division contracted with the University of Idaho to prepare a feasibility analysis for commercial biodiesel production in the Treasure Valley. The purpose of the study was to identify potential local sources of raw materials needed for such a facility, suggest possible sites for a plant, identify marketing options for the fuel produced and for all the potential by-products, and consider alternatives for biodiesel production. The study was to also identify economic and environmental barriers to the location of a successful plant for the production of biodiesel.

For purposes of this study, "The Treasure Valley" is defined as nine counties including Ada, Boise, Canyon, Elmore, Gem, Payette, Owyhee and Washington counties of Idaho and Malheur County in Oregon (Figure 2). Total land area of the Treasure Valley is 17 million acres. Of that 6.5% or 1.1 million acres are in cropland that is mostly irrigated.

The Treasure Valley is one of the most diverse cropping areas in the nation. Major crops include spring and winter wheat, barley, oats, potatoes, dry beans, alfalfa for both hay and seed, onions, mint, corn for silage and grain, sweet corn, vegetables, many different types of flower and vegetable seeds, and orchards.

> *"North, up and over the Owyhee Mountains, where a small range of hills that separate the desert from the Snake River is another one of Idaho's euphemistic valleys, the Treasure Valley. It is a combination of the Boise River Valley, the western reach of the Payette River, and the flattened shores of the Snake, to where it laps over onto Oregon at Ontario.*
>
> *The Treasure Valley is where most of Idaho's citizenry live. Boise, the capital city, is at the eastern end, from which spread westwardly bedroom communities as well as small acreages intensely farmed for mint, hops, beets, apples, cherries, and grapes. Boise is Idaho's only cityscape. The best vantage point is traveling westward on I-84. Four or five miles out, before exiting and dropping off the south bench, …" (Idaho Encyclopedia, Idaho Humanities Council, 2005)*

**Figure 2 – The "Treasure Valley" Study Area**



The study only considers available feedstocks and markets within the nine county area. Feedstocks outside the area could be used in a Treasure Valley biodiesel plant, however those plants might be preempted by a biodiesel plant in the area where the feedstock came from. Biodiesel fuel and byproduct markets outside the study area would be in competition with other biodiesel producers.

The Treasure Valley area is home to approximately 577,000 people in the major cities of Boise, Garden City, Meridian, Eagle, Nampa and Caldwell in Ada and Canyon Counties. Population is growing at about 2.55 % per year. An estimated 42% of the total population of Idaho reside within the study area while only 0.9% of the total population of Oregon are within the study area.

There are an estimated 537,000 motor vehicles in the area of which less than 10% are diesel. There is an estimated on-road diesel use of about 100 million gallons and 158 million gallons of total diesel use.

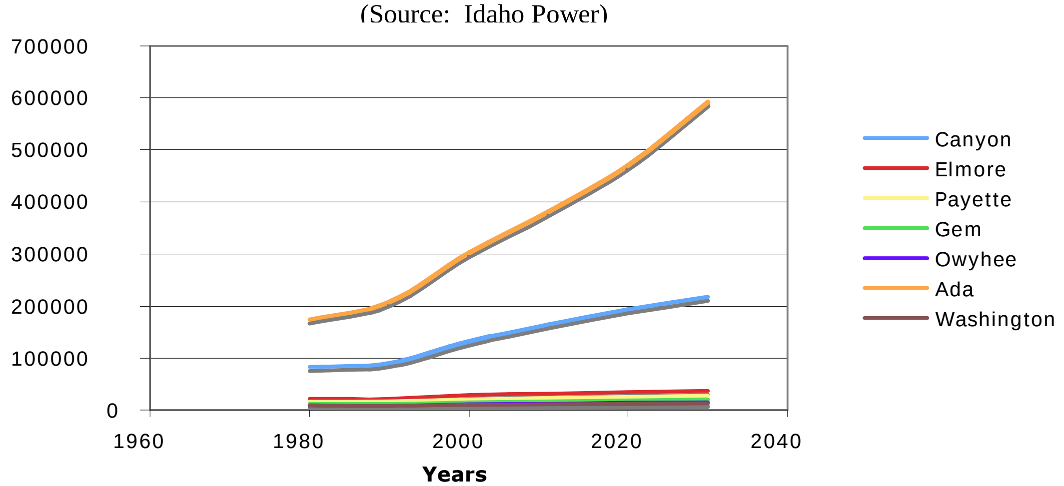
**Table 1 - Study Area Population by County**

| COUNTY | POPULATION |
|---|---|
| Ada | 312,337 |
| Boise | 7,011 |
| Canyon | 139,821 |
| Gem | 15,482 |
| Owyhee | 11,008 |
| Payette | 20,868 |
| Washington | 9,956 |
| Malheur , Oregon | 31,456 |
| **Total** | **577,096** |

From the U.S. Census 2002

This regional area has experienced enormous population growth in the past 10 years, which has stressed the limits of the transportation infrastructure. In the past six years, the daily traffic volumes on I-84 linking Ada and Canyon Counties increased nearly 50% and travel time to and from work has significantly increased due to higher traffic volumes and increased accidents. Recent population projections for Ada and Canyon Counties indicate an increase of an additional 25% from 1998 to 2005. These counties are expected to grow at the rate of 8,400 and 2,900 people per year for the next 20 years respectively (Table 1 and Figure 3).

**Figure 3 - Study Area Population Growth**
(Source: Idaho Power)



# III. BIODIESEL PRODUCTION

Biodiesel is a product made from vegetable oil or animal fat that can be used as a replacement for diesel fuel in diesel powered vehicles. The process is a chemical reaction involving alcohol, such as methanol or ethanol, into which is added a catalyst, such as sodium or potassium hydroxide. This mixture is blended into the vegetable oil causing a chemical reaction, called transesterification, which separates the vegetable oil into two components. One component is a heavier liquid called glycerol (also called glycerin). Glycerol has many food and industrial uses, such as cosmetics, toothpaste, pharmaceuticals, foodstuffs, plastics, explosives, and cellulose processing to name a few. However, the material obtained from biodiesel production requires purification before it could be used for these purposes.

The second component is called an ester of the oil or biodiesel. The ester is lighter than the glycerol and so rises to the top after the reaction is complete. The ester, after carefully washing to remove all remaining catalyst, alcohol and glycerol, can be used as a fuel in diesel engines. The esters are good solvents, cleaning agents, and also used in cosmetics. They have been used to prevent asphalt from sticking to metal such as truck beds, and are used as surfactants in agricultural chemicals. They are lubricants and have other similar uses.

**Feedstock**

The first step in the production of biodiesel is obtaining a suitable vegetable oil or animal fat (feedstock). The sources are 1) collection of used oil commonly called yellow grease from delis, fast food restaurants, or processors, 2) collection of tallow from slaughter houses and packing sheds, 3) purchasing yellow grease or tallow from an existing renderer, 4) contracting production of vegetable oil seeds from local farmers, 5) purchasing clean seed from an existing warehouse or seedsman, or 6) purchasing vegetable oil from an existing crushing plant.

The availability of feedstock sources in the Treasure Valley is discussed in the following chapter. Although yellow grease and tallow are available, there is a limited supply, existing markets, and generally make it more difficult to produce a quality fuel than biodiesel produced from virgin oils. Since there are currently no commercial seed crushing plants in Idaho, plants using virgin oil would need to either purchase and transport oil from outside the state or build a seed processing facility. While an assessment of developing a crushing plant is beyond the scope of this study, that operation may be more costly and larger in scope than the biodiesel production plant.

**Figure 4 – Seed Crusher at the University of Idaho**

**Biodiesel Processing and Plant Design**

The technologies utilized to produce biodiesel from the variety of potential feedstocks vary from simple to complex. Since the commercial production of biodiesel is a new industry the current trend for plants currently operating or under development is that each facility uses its own proprietary process. It is likely that as the industry matures processes will become more standardized and efficient. The ultimate goal of whatever process is selected is to produce a biodiesel at minimum cost that meets ASTM specifications.

Currently the method most commonly used is the base catalyzed esterification with methanol, generally referred to as the methyl ester process. Essentially it consists of dissolving a catalyst such as potassium hydroxide or sodium hydroxide into the methanol and stirring this mixture into a tank of vegetable oil or animal fat. In some processes the reaction is completed at room temperature but more commonly the mix of oil and catalyst is kept just above the boiling point of the alcohol to speed up the reaction. Reaction time varies from one to eight hours. Excess alcohol, typically 100-percent excess, is used to ensure total conversion of the fat or oil to its esters. After the separation of the ester from the glycerol, excess alcohol is removed by evaporation. The following is the most basic recipe that is used for producing biodiesel.

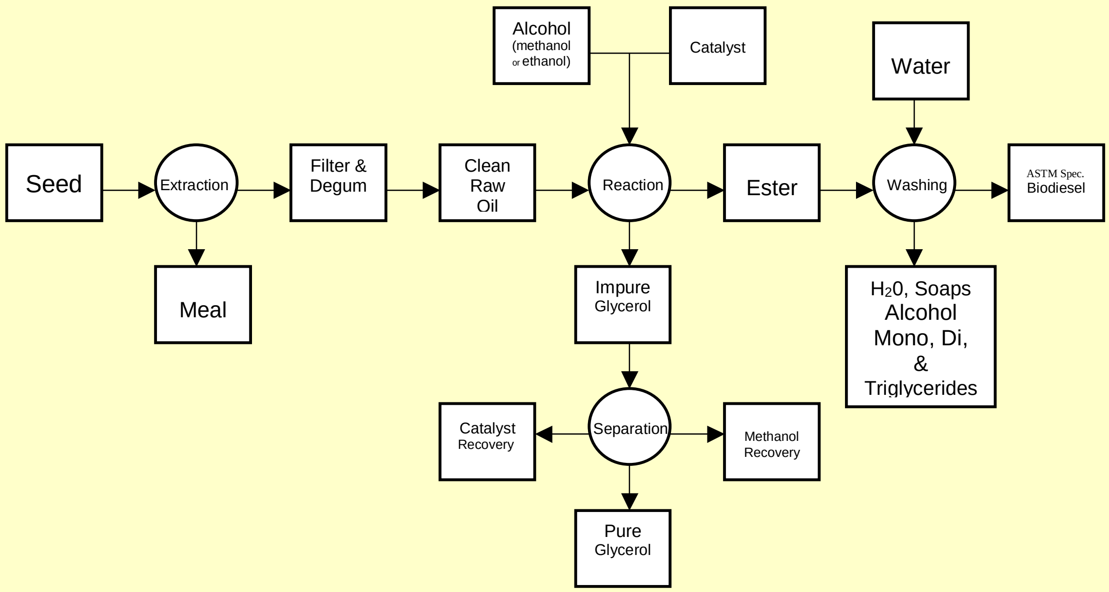
Methyl ester ingredients ⟶ Methanol = 0.225 x oil quantity in liters
KOH = Oil quantity in kilograms/100

While not commonly done in commercial plants ethanol can be used to replace the methanol but the amount of ethanol is slightly higher (oil in liters/0.27).

Biodiesel has been produced from nearly all types of vegetable oil and animal fat. Some of the feedstocks may require pre-processing processes like refining, degumming or filtering to improve the oil quality and to improve the yield of biodiesel. The oil must be dry or moisture must be removed by pre-heating and the alcohol must be anhydrous. Moisture will prevent the process from going to completion. Titration of the oil is used to determine the amount of catalyst required depending on the acidity of the fat/oil. If the fats/oils are high in free fatty acids (FFA), exceeding 3 or 4 percent, an acid treatment can be used prior to the esterification process to convert the FFA to esters.

The esterification reaction results in four main products – the methyl ester or biodiesel, glycerin which in the pure state has significant value, feed quality fats from unreacted triglycerides, and methanol that can be recycled back into the process. While the technology is a well-established process there are many different variations to achieve the desired result. In general terms the processing can be done by batch, semi-batch or continuous production. A schematic of the batch process is shown in Figure 5. The batch process, the simplest method for producing biodiesel, utilizes time to achieve separation of the various solutions created during the transesterification and washings to achieve quality biodiesel fuel. For more information on the chemistry and process of producing biodiesel refer to Van Gerpen, 2005 and Knothe, 2004.

**Figure 5 - Schematic & Description of the Batch Process**




## Biodiesel Production Batch Process

Dissolve the catalyst in the alcohol (methanol or ethanol), or purchase a pre-blended mixture. Add the alcohol/catalyst mixture to the oil and stir the mixture vigorously. After two hours of stirring allow the mixture to settle for eight to twelve hours for the ester and glycerol mixture to separate. The heavier glycerol settles to the bottom and can be removed in a separatory funnel or with a centrifuge.

Following esterification additional processing is required to produce a suitable biodiesel. To assure meeting the glycerol standard some plants use a second esterification with about 10% the amount of alcohol to react any triglycerides remaining in the ester.

A water washing process is used to remove any remaining excess alcohol, glycerol, and triglycerides. Washing must be done carefully, especially processes using ethanol. If the process is not done carefully emulsions may form between the esters and the water. Water is sprayed at low velocity on top of a tall column of biodiesel. The water filters down through the biodiesel column carrying with it the remaining alcohol and glycerol. Following washing the ester is again allowed to settle so that the water will settle to the bottom where it can be removed. In some commercial operations the biodiesel is raised to a temperature just above the boiling point of water to evaporate any remaining water.

The process equipment for producing biodiesel is a series of tanks, pipes, pumps, heat exchangers, condensers, and valves. Figure 6 shows the requirements for a 1,000,000 gallons per year production plant with 30 days of on-site storage. Several commercial companies offer biodiesel processing plant design services. There are also companies offering skid mounted modular biodiesel plants for sale. Potential purchasers should investigate the process, sources, and suppliers very carefully to assure a quality installation and fully investigate the success of the contractor's previous installations. Regardless of the size or design of the plant development of operation should largely follow the development process flow chart shown in Figure 7.

**Figure 6**

## Plant Requirements

**For a**

## 1,000,000 gallons per year Biodiesel Production Plant

**With 30 days of on-site storage**

1. The input side of the plant would need facilities to store 85,000 gallons of vegetable oil and 20,000 gallons of methanol.

2. If the oil were derived from seed, since most vegetable oil crops suitable for Idaho are annual crops, storage would be necessary for approximately 10,000 tons (350,000 bushels) of 40% oil seeds. This storage could be on-site or could be arranged off-site with local producers and/or growers.

3. If operated 300 days per year, the plant would need to process approximately 3,500 gallons of vegetable oil/animal fat per day.

4. If water requirements were 50% of the biodiesel process, approximately 2,000 gallons of water would be needed each day.

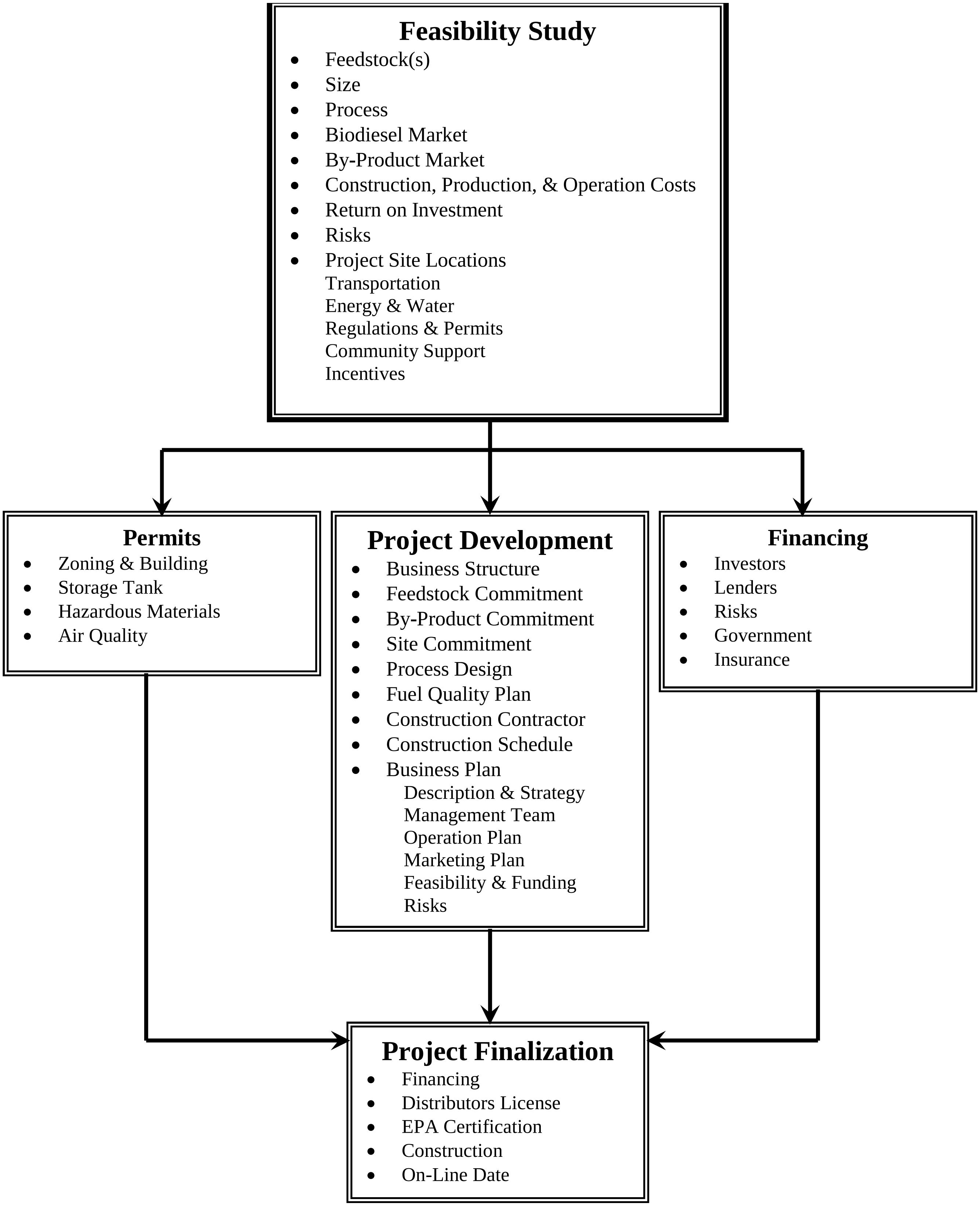
3. On the output side of the plant to have 30 days storage would require approximately 85,000 gallons of biodiesel, and 10,000 gallons of glycerol.

4. A methanol distillation unit would be required to remove excess methanol from 350 gallons of glycerol daily.

5. Rail or truck facilities would require 4 – 5,000 gallon loads of methanol per month; 17 – 5,000 gallon loads of fat or oil per month or 500 - 20 ton loads of oil seeds per year; 325 - 20 ton loads of meal leaving the plant per year; 17 – 5,000 gallon loads of biodiesel per month leaving the plant; and 2 – 5,000 gallon loads of glycerol leaving the plant per month.

**Figure 7**

# Project Development Flow Chart



**Fuel Quality**

For a commercial operation there is no more important factor than producing a quality product. It is relatively easy for someone, even in his or her backyard, to produce a biodiesel fuel. It is not as easy or as inexpensive for one to produce a quality fuel that will meet requirements of a modern diesel engine. One of the first actions of the biodiesel industry was to develop a standard for biodiesel. This standard, known as "The Biodiesel Standard", was created under the auspices of the American Society of Testing Materials (ASTM D 6751, Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels). The purpose is to provide a biodiesel product that meets the requirements for blending with diesel fuel in a manner that will not adversely affect engine operation or drivability. The complete standard can be purchased from ASTM. Further information on the standard is available on the ASTM website.

Every commercial biodiesel plant should have a plan for regular testing of its product to assure compliance. Table 2 provides an overview of the requirements. There are commercial operations that can perform the tests for a fee although there could be a large time lapse. Larger plants will need an analytical laboratory capable of performing many of the tests on-site.

**Table 2 - Summary of Biodiesel Fuel Standard***

| PROPERTY | LIMITS | METHOD |
|---|---|---|
| Flashpoint | 130 ºC Min | D 93 |
| Water & Sediment | 0.050 % by volume max. | D 2709 |
| Kinematic Viscosity, 40 ºC | 1.9 – 6.0 $mm^2/s$ | D 445 |
| Sulfated Ash | 0.020 st. % max | D 874 |
| Total sulfur | 0.05 wt % max | D 5453 |
| Copper Strip Corrosion | No. 3 max | D 130 |
| Cetane Number | 47 min | D 613 |
| Cloud Point | Report to customer | D 2500 |
| Carbon residue | 0.050 wt. % max | D 4530 |
| Acid Number | 0.80 mg KOH/g max | D 664 |
| Free glycerin | 0.020 wt. % max | D 6584 |
| Total glycerin | 0.240 wt. % max | D 6584 |
| Phosphorous | 0.0010 wt % max | D 4951 |
| Vacuum Distillation End Point | 360 ºC max at T-90 | D 1160 |
| Storage Stability | N.A. | Not yet developed |

*ASTM D 6751, " Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels," ASTM International. For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

The approved specification for biodiesel ASTM D 6751 requires a sophisticated knowledge of the chemistry of producing biodiesel. The tests to ensure the quality of the fuel require expensive equipment. A small facility would require the same process quality assurance testing as a large one.

It is important to the industry that all commercial operations have a regular schedule for running all of the recommended tests suggested in the standard. When the U of I conducted the 200,000-mile Over-the-Road test of biodiesel in a large truck (Peterson, 2002), the tests were divided into two groups. The first group consisted of those portions of the standard that were not likely to change from batch to batch. In the second group were properties that could. Tests done for each batch included viscosity, free and total glycerin, flashpoint, and acid number. A separate and longer test interval was established for the second group of tests.

In addition to the standard, the National Biodiesel Board has established a BQ-9000 quality assurance program. As stated on the NBB website, "The National Biodiesel Accreditation Program is a cooperative and voluntary program for the accreditation of producers and marketers of biodiesel fuel called BQ-9000. The program is a unique combination of the ASTM standard for biodiesel, ASTM D 6751, and a quality systems program that includes storage, sampling, testing, blending, shipping, distribution, and fuel management practices. BQ-9000 is open to any biodiesel manufacturer, marketer or distributor of biodiesel and biodiesel blends in the United States and Canada."

Regardless of whether a company elects to participate in BQ-9000 or develop its own quality control program it is important to the future of the biodiesel industry that biodiesel placed for sale be of good quality. Diesel engines have many critical components that can be damaged resulting in expensive repairs if fuel clogs filters, contains water, has incorrect viscosity, has high acid value or is sub-standard in any of the other quality factors is allowed to enter the fuel system. When producing biodiesel as with any other product "Quality" must come first.

**Engine Manufacturer Warranty Information**

Most of the major engine manufacturers have released statements on biodiesel use relating to their engine warranties. In general they state that engine warranties are associated with failure due materials and workmanship regardless of the type of fuel used. Most suggest that only ASTM standard diesel fuel be used in their engines with some recommend a maximum of 5% biodiesel blended with diesel. Several of these statements can be found on the National Biodiesel Board website at: www.biodiesel.org

It is very likely that one of the impediments to acceptance of higher percentage blends of biodiesel by the engine manufacturer's is the wide spread lack of adequate quality controls in the processing of biodiesel by smaller producers. A second impediment is that biodiesel is still a relatively new fuel. As many millions of miles/hours of use are achieved it is likely that these recommendations will be liberalized if in fact general use of biodiesel is found to have no or few problems. Quality assurance by all segments of the industry, including both small and large producers, is essential if biodiesel is to be accepted as a standard component of transportation fuels.

# VI. FEEDSTOCK AVAILABILITY

Feedstocks for locally produced biodiesel can come from used oil from restaurants and food processing facilities, tallow from beef packing plants and similar sources or oilseed crops grown specifically for biodiesel production. The fact that biodiesel can be produced from recycled cooking grease, or what is commonly called "yellow grease", is partly the reason for the current publicity and excitement about biodiesel. Yellow grease is the cheapest feedstock but the supply is limited. There is competition for the available supply for uses other than biodiesel, and its use for biodiesel generally requires pre-processing. The largest type of feedstock currently available in the Treasure Valley is tallow because of the large number of cattle slaughtered in the area. Tallow is also the most problematic potential source. It is not the best feedstock for biodiesel production because it has a high free fatty acid content and the highest pour point of all the feedstocks.

The most desirable feedstock, and also the most expensive, is oil from seed crops, commonly called virgin oil. Soy oil is the largest seed crop and feedstock used to produce biodiesel in the United States. Soybeans could be grown in the Treasure Valley but there is no current production and the experiments at the Parma Experiment Station have not shown promising results. Varieties developed for the area might increase the feasibility of soy oil production in Idaho. Safflower and sunflower have been grown in the Treasure Valley on a limited basis. Perhaps the greatest potential for producing biodiesel from locally grown crops in Idaho is rapeseed, canola and mustard from the Brassicas family. Brassica crops are grown across Idaho and can be grown in the Treasure Valley. At the present time, however, a State Department of Agriculture Order limits the production of Brassicas in much of the Treasure Valley. Oil from rapeseed and canola are considered premium feedstocks for biodiesel.

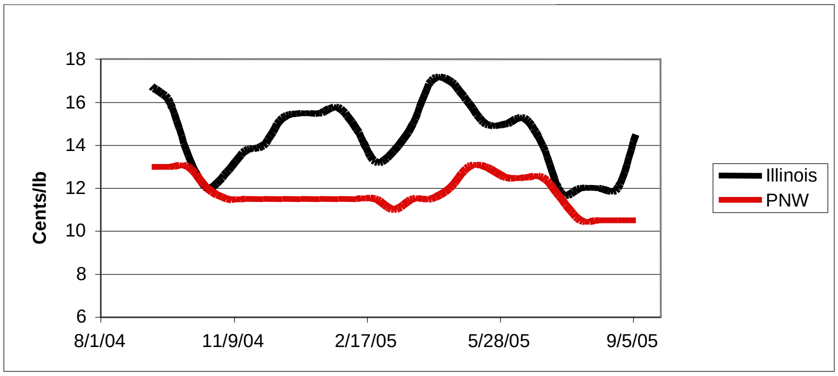
A potential biodiesel plant developer might also bring in oil by rail from other areas. While this may be a reasonable approach to developing a plant in the Treasure Valley, it is beyond the scope of this study.

**Used Oil**

According to estimates by the National Renewable Energy Laboratory (NREL) the quantity of used oil from restaurants and similar sources is about 1.1 gallons per person per year (Wiltsee, 1998). In the Treasure Valley that equates to 634,700 gallons per year. Based on discussions with renderers about 1 million gallons per year may be handled in the valley but the collection area is significantly larger than the nine county study area. There also may be an additional 0.5-2 million gallons per year from potato processors. The value of yellow grease fluctuates over time and by location. Figure 8 shows the range of prices over the past year in the Illinois and Northwest.

Used oil in the Treasure Valley is currently collected, processed, and then resold for feed, domestic industrial markets, and exported. One of the major rendering companies indicated that up to 80% of the used oil collected on the west coast was currently being exported. Some of the local processors also indicated that they would be reluctant to redirect their current used oil sales from traditional purchasers to new industries like biodiesel. Consequently, some of the used oil in the Treasure Valley may not be available for biodiesel production. To obtain yellow grease for biodiesel the facility would need to either purchase the product from existing renders or set-up its own collection business in competition with the existing companies. The latter option should not be considered trivial. Purchasing trucks, hiring drivers, arranging for collection tanks with the various businesses, obtaining contracts, filtering and cleaning the oil all add cost to the oil.

**Figure 8 - Yellow Grease Prices**




Source: Jacobsen Publishing Company

**Tallow**

Based on interviews with many of the meat packers it is estimated that 56,000,000 pounds of tallow are being produced in the Treasure Valley. At 7.5 pounds per gallon this equates to 7.47 million gallons of oil. Recent changes in livestock feed regulations due to mad cow disease and other related problems have restricted the markets for this product. If process technology can be developed to successfully use tallow for biodiesel it is currently the most abundant and cheapest source of oil available in the Treasure Valley. Tallow pricing is generally a few cents per pound higher than yellow grease. As with yellow grease, a biodiesel facility would need to either purchase the tallow from existing collection companies or compete with them. Challenges with tallow for biodiesel production include high FFA content, high pour point and process requirements to produce a liquid.

The availability of tallow is dependent on a thriving meat packing business. Shifts in the size or location of these facilities would have a resulting effect on the biodiesel plant. As with yellow grease, there are uses for tallow, which would preclude some of the product from being used for biodiesel production. And as with yellow grease, either it would need to be purchased from an existing render or facilities and equipment would need to be developed to pickup and render the tallow useable for biodiesel production and to arrange for disposal of non-oil fractions.

**Oil From Local Seed Crops**

The Treasure Valley is one of the world's most productive and diverse agricultural regions. The mild desert climate and long summer days of this area provide good conditions for the production of nearly one hundred different crops. Traditional crops are potatoes, sugar beets, grains, and alfalfa. The valley is a major area for the production of dry onions, sweet corn and vegetable seed crops and does well with many specialty crops such as fruits, mint, Christmas trees and hops. Most of the Treasure Valley receives 10 to 11 inches of precipitation each year and most of the farmland is irrigated.

The total cropland in the Treasure Valley is about 1.1 million acres. Table 3 shows the breakdown of cropland area by county. In 2004, there were approximately 809,000 total acres harvested for crops. About 10,000 acres of the total were orchards and other permanent crops, leaving about 800,000 acres available for annual crops. In recent years the Treasure Valley has been losing a significant acreage of farmland to urbanization. Canyon County, the largest Idaho agricultural county in the study area, lost 30 percent of its farmland from 1992 to 2002. In an analysis of the Boise River watershed, one farm researcher found a 6.7 percent loss in farmland between 2000 and 2004 (Idaho Statesman, June 2005).

**Table 3 - Greater Treasure Valley Agricultural Area, 2004**

| County | Total Acres | Crop Acres |
|---|---|---|
| Ada | 675,416 | 89,540 |
| Boise | 1,217,670 | 6,956 |
| Canyon | 377,721 | 235,077 |
| Elmore | 1,970,551 | 126,529 |
| Gem | 360,435 | 47,908 |
| Payette | 261,704 | 57,969 |
| Owyhee | 4,915,493 | 157,795 |
| Washington | 932,136 | 107,423 |
| Malheur County, OR | 6,329,706 | 278,780 |
| TOTAL | 17,040,334 | 1,107,977 |

Source: Idaho Agricultural Statistics, 2004 & USDA Agricultural Statistics, 2004.

In order for farmers to successfully grow seed crops in the Treasure Valley the crop must fit in with the growers' rotation and provide a reasonable financial return to the grower. Typical crop rotations for the irrigated regions of the Treasure Valley are shown in Table 4. Crop rotation is necessary for weed and disease control. Oilseed crops are not likely to replace the major cash crops like potatoes, sugar beets, onions, and, recently alfalfa, but could replace the small grains. Some growers may prefer oilseed crops for rotation since they have some advantages over those currently grown. Oilseed crops will still need to provide a return to the farmer at least comparable to the crops currently used for rotation. Based on comparisons with other crops used for rotation it was estimated that area growers would need to receive about $300 per acre on irrigated land in order to grow oilseed crops. A graph of the yield and price paid to farmers corresponding to $300 per acre is shown in Figure 9.

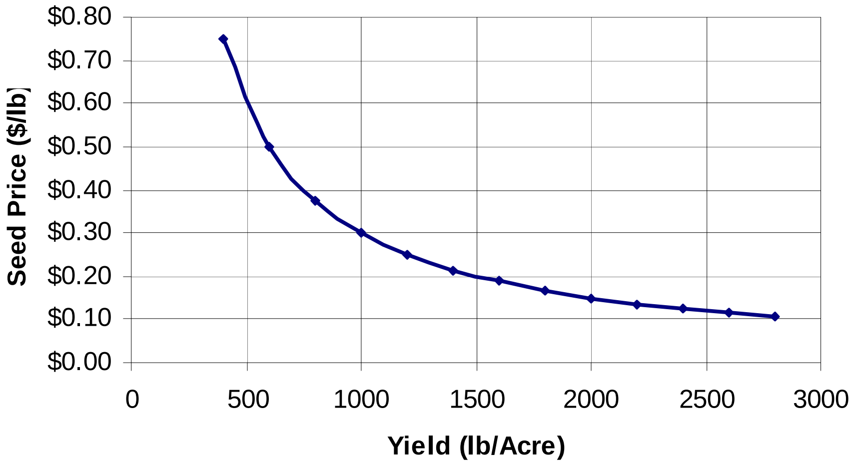
**Table 4 – Typical Crop Rotations for the Treasure Valley**

| | Rotations* | |
|---|---|---|
| Crops | 8 Year | 12 Year |
| Grain | 25 | 25 |
| Alfalfa seed (3 yr.) | 15 | 15 |
| Potatoes/sugar beets | 25 | 25 |
| Corn | 25 | 0 |
| Dry beans/onions | 10 | 10 |
| Mint (4 Yr) | 0 | 25 |

*As percent of available cropland

Four oil seed crops will be discussed with relation to their potential success in the Treasure Valley: Brassicas, safflower, sunflower, and soybeans. Most seed crops grown in the United States and in Idaho are dry land farmed. The information available for these crops in the study area, which is primarily irrigated, is limited. Much of the following discussion is based on interviews with agricultural extension agents, farmers and others familiar with farming in the study area. Growers planning to use these crops for biodiesel production should conduct field trials under their conditions to determine yield potential.

Figure 9 - Crop Yield and Seed Price to Farmers at $300/Acre




***Brassicas***

Oilseed rape (Brassica and related species, Brassicaceae) is now the second largest oilseed crop in the world, providing 13% of the world's supply (Raymer, 2002). Brassicas are the mustard family, also known as "crucifer," which includes rapeseed, canola, yellow mustard, cabbage, and turnips, as well as many weeds and garden vegetable species. Although rapeseed can refer to both the edible and industrial oil types, it has become common to mean the non-edible type. Rape is classified as an industrial crop because of its high erucic acid content, which is used in lubricants, diesel additives and to manufacture plastics. Canola is rapeseed that meets food quality standards with low levels of erucic acid and sulfur containing compounds called glucosinolates.

Canola and rape are cool season crops, which are grown in the northern plains area of the United States and Canada. There are both winter and spring cultivars. Canola and rape are commonly grown in the Palouse area of northern Idaho and eastern Washington, the west-central Idaho Camas Prairie and the American Falls area. The University of Idaho has in fact used Brassicas grown on the Palouse extensively in biodiesel research (Figure 10). In 1996, Idaho planted about 6 percent of the national acreage.

**Figure 10 - UofI Volkswagen, which runs on 100% biodiesel from mustard seed oil, sits on a Rapeseed field on the Palouse.**


At the present time Brassicas cannot be grown in most of the Treasure Valley. The Idaho Department of Agriculture Order limits the production of Brassicas to Elmore, Owyhee south of Murphy and Washington. There is also a recently revised Oregon Agricultural Order that affects Malheur County. Figure 11 summarizes the content of both state orders and the revision being considered for Oregon.

Brassicas are well adapted to the dry land farms of the Pacific Northwest and provide important advantages in a sustainable crop rotation system with wheat. They break up pest cycles and help minimize the use of synthesized chemical pesticides. The University of Idaho has reported that rapeseed and related crops also may reduce disease populations in potatoes when the crop followed rapeseed or rapeseed as a green manure. Populations of nematodes, potato scab, and rhizoctonia were reduced by crops with high glucosinolates (Findlay, 2003). They also condition the soil so that follow-on wheat crops provide better yields. Existing small grains equipment can be used to plant these crops, but the seedbed must be more uniform and weed-free than for the small grains (Weber, 2005).

**Figure 11 - Summary of Idaho and Oregon Agricultural Rapeseed Orders**

## Idaho Administrative Code

In 1993 and 1994 the State Department of Agriculture issued an administrative ruling IDAPA 02.06.13 pertaining to the production of rapeseed and Canola within the state. The purpose is to 1) control diseases of the Brassica genus particularly blackleg (Leptosphaeria maculans), 2) to protect genetics of developed varieties, and 3) to protect the vegetable seed industry in southwest Idaho.

There are two administrative districts that fall within the boundaries of the feasibility study area. District IV includes Ada, Canyon, Gem, Payette, and Owyhee north of Murphy. District V includes Elmore, Washington and Owyhee south of Murphy. For District IV the rule states that no rapeseed of either variety may be planted in the district. In District V the rules state that the industrial types of rapeseed may be planted under these conditions:

1) It is the responsibility of the person planting industrial types of rapeseed to consult with and obtain written approval from all farmers bordering the fields to be planted with industrial types of rapeseed.
2) Industrial types of rapeseed must be at least one (1) mile from a field planted to edible types of rapeseed.

In all areas of Idaho, Brassica seed produced outside of the state must be treated with a registered fungicide for the control of blackleg and have a certificate stating the seed is blackleg free. Transport of all Brassica seed must be covered or in sealed containers or vehicles to avoid accidental spread of the seed.

## Oregon Agricultural Order

Recent revisions to the Oregon agricultural order (OAR 603-052-880) places most of Malheur County in a General Production Area where Brassicas can be grown for any purpose. Rapeseed production is prohibited within a 3-mile wide strip of land along the Idaho border where Idaho's agricultural order prohibits rapeseed. Production in the General Production Area must:

1) be certified seed and have a certificate the seed is blackleg free. The seed must also be treated prior to planting with an approved blackleg fungicide,
2) not be grown on the same plot of land more often than two years in every five; To prevent buildup of blackleg disease,
3) and, be placed in enclosed bins or in containers lined and covered in a manner to prevent seed loss when transported through Protected Districts.

There is limited available information on the success of growing Brassicas under irrigation. In northeastern Colorado, it was found the yield was linear to water at 175 pounds per acre per inch of water after the first 6.22 inches. Water extractions were from the top 47 inches of the soil profile. Rape was most sensitive to water stress during the grain-filling stage and least sensitive during vegetative development (Nielsen, 1996).

A farmer in Camas County near Fairfield has grown canola under both dry land and irrigated conditions near an elevation of 5,020 feet. In 1989, 35 acres of spring canola were planted under irrigation, which was limited to 8 inches of water. The yield was 2,500 pounds per acre. In 1991, 525 acres were planted under dry land conditions, which was the first year of the drought. The crop received no rain that season and the yield was only 200 pounds per acre. The dry land crop had higher oil content, about 42%, than the irrigated one. Recently the farmer has been growing yellow mustard under organic conditions as a dry land crop. About 100 to 150 acres are planted each year with a yield of 200-300 pounds per acre (Frostenson, 2005).

The 2004 state average yield for canola was 1,500 pounds per acre (Idaho Agricultural Statistics, 2005). On the Camas Prairie near Grangeville rape is dry land farmed and yields of 3,000 pounds per acre are common. The wide range in rape yields demonstrates the affect climate has on the crop. Rapeseed in Idaho is used for birdseed or shipped out of state for processing.

Yellow mustard (Sinapis alba L.) is another Brassica crop that is widely discussed for potential feedstock for biodiesel. According to Brown et al. (2005) yellow mustard is a spring annual well adapted to hot, dry growing conditions. It has superior heat and drought tolerance compared to rapeseed or canola. It has 55% higher seed yield than canola in areas of the Pacific Northwest that receive less than 12 inches of rainfall. It also has higher yields than spring canola in areas that receive more than 12 inches of annual rainfall. Yellow mustard is a relative of canola, rapeseed and oriental mustard but will not cross-pollinate with these crops under field conditions.

Four years of field trials with yellow mustard on dry land in the Pacific Northwest averaged 1,419 pounds per acre. Brown, et al. (2005) report that the expected average seed yield can be found by multiplying the expected rainfall in inches by 95 pounds per acre up to 18 inches of rainfall. A grower in the 12 inch rainfall area could expect 1,140 pounds per acre. However, many other agronomic factors, such as seeding time and rate, weeds, fertilizer, soil type, disease and insect control, can also influence the yield. Unfortunately, the oil content was not reported. Peterson et al. (2001) reported that two cultivars of yellow mustard had 27 percent and 35 percent oil content respectively. Similar oil contents were reported by Oplinger et al. (1991). Using 1,500 pounds per acre, 35 per cent oil, and 90 percent extraction efficiency would give an estimate of 63 gallons per acre of yellow mustard oil. Peterson et al. (2001) reported results similar to other Brassica oils in so far as potential for biodiesel was concerned.

Reportedly, additional benefits of yellow mustard are reduced production inputs, potential use of meal for condiment mustard and for a soil amendment to replace or reduce herbicides and pesticides. Because the meals are high in glucosinolates they are not suitable for livestock feed.

The oil content of Brassicas is about 40 to 45-percent, compared to about 20 percent for soybean. Tests at the University of Idaho also indicate Brassica oils provide superior low temperature properties for the biodiesel. Brassica crops have high levels of mono-unsaturated fats and low levels of saturated fats, usually between 4 and 6% but less than 2% for some varieties. The saturated fatty acid chains determine the gel point of the fuel and when the level of saturates are 14-15%, as is typical of soybean oil, the fuel will gel at about 32ºF. When the level of saturates is 40%, as in animal fats and recycled restaurant frying oils, the fuel will gel at 50 to 55ºF. Preliminary testing shows that Brassica-based biodiesel is lower than soybean oil but still cannot approach the cold weather performance of conventional diesel. Brassica has a gel point of 20-25ºF while No. 2 diesel has a gel point of 1-15ºF (He, 2006).

***Safflower***

Safflower (*Carthamust Tintorius* L.) is a member of the thistle family. It is grown for oil and birdseed in plains of Canada and the western plains states of North and South Dakota, Nebraska, Colorado, Texas, and in California. Safflower is a deep-rooted long season annual that can grow on dry and irrigated lands. Its tap root system can utilize moisture and nutrients in the soil below that of small grains. (Lethbridge Research Center, 2004 and Berglund, 1998)

Safflower provides meal, oil, and birdseed. Both the food and industrial segments use safflower oil, which can be high in monounsaturated fatty acid (oleic) or high in polyunsaturated oils (linoleic). The oil content of cultivars varies from 30 to 45 percent. The meal, which is about 24 percent protein and high in fiber, is used as a protein supplement for livestock and poultry.

Although safflower is often considered a dry land plant, it does respond well to irrigation. It can produce a seed crop on as little as 16 to 18 inches of moisture. In the central valley of California under irrigation, about 20 to 25 inches of water is required for economic yields. With 25 to 40 inches of rain/moisture the relationship is about 100 pounds of seed per inch of evaportranspiration (University of California, Davis. 1999). In field plots in Montana and North Dakota, safflower out produced sunflower, mustard, soybean, crambe, flax, and rapeseed (Croissant, 2005). In North Dakota about 5 pounds of nitrogen is required per 100 pounds of seed produced (Armah-Agyeman, 2002).

Safflower has been grown within the study area in both Canyon and Washington counties. The safflower grown in Canyon County was an Ethiopian confectionary variety, with a yield of about 3,000 pounds per acre. In Washington County, where total moisture is about 10 to 11 inches per year, a farmer has grown safflower for 20 years. Most of it has been a white seed S208 variety grown for birdseed with an oil content in the 40 to 42 percent range. As a dry land crop, yields ranged from 800 to 1,000 pounds per acre. As an irrigated crop, the yield ranged from 1,500 to 3,800 pounds per acre. The farmer found that yields were lower if the crop was irrigated during flowering and returns were greater for safflower than for small grains (Lolley, 2005).

Safflower is reportedly a good crop to grow on hard soils since the deep root system will penetrate and fracture the soil. It is best to plant early so that flowering can occur before the hot period of late summer. This practice was also said to reduce the occurrence of *Phytophthora* spp., a disease that has the potential to greatly reduce yields.

***Sunflower***

Sunflower *(Helianthus annuus* L.) is a plant that was used for food by the North American Indians before European colonization. The sunflower has traveled the world since then, and been hybrized into two types: confection (non-oil) and oil types. The oil content of the varieties can vary from 38 to 50 percent (North Dakota State University Agricultural Experiment Station, 1995).

As with safflower, sunflower has a deep root system that can extract water and nutrients from the soil profile deeper than small grains. It responds to irrigation with yields increasing at about 150 pounds of seed per inch of water after the first 7 inches. Row crop equipment appears to work better than small grain equipment to farm sunflowers. It should not follow itself in crop rotation in less than 4 years to manage diseases (North Dakota State University Agricultural Experiment Station, 1995 and Thomas Jefferson Agricultural Institute, 2005).

Sunflower was evaluated in alternative crops trials for the Palouse country of north Idaho and eastern Washington by Kephart (1990). The seed production did not fare well due to different equipment required, the dry, hot summer environment, and limited production experience. Sunflowers have also been grown in southwest Idaho. The crop is harvested with modified small grain combines. In all cases black birds and starlings imposed a great deal of damage to the yields (Shock, 2005).

***Soybeans***

In contrast to other oil seed crops mentioned above, soybeans produce oil content of 17 to 20 percent. To extract the soybean oil on a commercial basis, in the Midwest a hexane solvent extraction process is used (Feibert, 1999).

Commercial varieties of soybeans are not adapted to Treasure Valley’s cool night temperatures and low relative humidity. The Oregon State University Malheur Experiment Station is developing varieties of soybeans that are adapted to the area’s climatic conditions. Some new varieties are yielding 40 to 60 bushels per acre. The meal remaining from extracting oil from soybeans is a widely used high protein product desirable for livestock feed and many other uses.

**Potential Production of Oil from Local Seed Crops**

Oils can be extracted from oilseeds by either mechanical press (expeller) or solvent extraction. The chemical solvent extraction, or the hexane process, is very effective leaving about 1 percent oil in the meal. Most of the soy oil produced is from the hexane process but it is expensive and hazardous. Physically pressing the seed is less effective, leaving about 9 percent oil in the meal, but produces a meal that has greater value. Since there are currently no commercial seed processing plants in Idaho, plants using oil from local seed crops would need to build a seed processing facility. While an assessment of developing a seed processing plant is beyond the scope of this study, that operation may be more costly and larger in scope than the biodiesel production plant.

The Integrated Cropping Systems group at Prosser, Washington has been evaluating the production aspects of seed crops for biodiesel production in high value irrigated vegetable rotations. One of their objectives is to determine the best yielding cultivars as a biodiesel feedstock for the Pacific Northwest. A summary of their findings as they related to the Treasure Valley is shown in Table 5.

**Table 5 – Yield Data for 2004-05 Trials at Patterson, WA***

| CROP | VARIETY | YIELD (LB/AC) | Oil Content (%) | Biodiesel Yield (gal/ac) | Area need to support 5-Mil Gal Facility |
|---|---|---|---|---|---|
| Spring Rapeseed | Garnel | 1,876 | 40-45 | 113 | 44,334 |
| | Sterling | 1,770 | 40-45 | 108 | 47,058 |
| Spring Mustard* | Idagold | 1,306 | 25-27 | 52 | 95,466 |
| | Pacific Gold | 2,194 | 25-27 | 88 | 56,862 |
| Safflower | CA | 2,545* | 42-48 | 146 | 34,250 |
| Soybeans | S191B-4 | 3,881 | 20-22 | 104 | 48,227 |

*Source: Collins et. al., 2005

Based on the current rotational practices of area farmers it was determined that oilseed crops could reasonably be expected to be planted on 8-15% of the cropland in the study area. Actual acreage will depend on price, success of the growers with the crop and crop rotation, but cannot presently exceed one in four years because of the Agriculture Order for disease control. The state average yield for Canola is 1,500 pounds per acre Idaho Agricultural Statistics, 2005). It is believed that growing oil seed crops in the Treasure Valley under irrigation would result in yields greater than those published for Canola. For the following estimates it was assumed that the average yield under irrigation would be in the 1,500 to 2,200 pounds per acre range, the oil content of the seed 40 percent, the press recovery 90 percent, and that a gallon of oil weighs 7.5 pounds. Using these estimates an acre of oil seed crop would produce the equivalent of 72 to 106 gallons of biodiesel per acre. The estimated oil production from local seed crops, shown in Table 6, ranges from 4.7 to 17.5 million gallons per year

**Table 6 - Estimated Oil Production from Local Seeds Crops**

| | RANGE | |
|---|---|---|
| | LOW | HIGH |
| Total Cropland | 1,100,000 Acres | |
| Harvested Acres | 810,000 | 1,100,000 |
| Acres for Oil Seeds | 65,000 | 166,000 |
| Oil Production @ 1,500 lb/acre* | 4,680,000 Gallons | 11,952,000 Gallons |
| Oil Production @ 2,200 lb/acre | 6,840,000 Gallons | 17,529,600 Gallons |

*State average yield

## Feedstock Production Summary

It is estimated that no more than half of the available used oil and tallow could be obtained for biodiesel production. The potential range for growing a local seed crop depends on if the crop can provide a reasonable rate of return to the grower and whether the crop fits in the farmer's rotation. It is currently limited because the Agricultural Order for limiting Brassicas in the study area. Table 7 shows the estimated range of the biodiesel production from the various feedstocks.

**Table 7 - Summary of Potential Feedstock Sources**

| FEEDSTOCK | SUPPLY (MILLION GALLONS) |
|---|---|
| Waste grease* | 0.3 to 0.5 |
| Oil from food processing* | 0.2 to 1 |
| Tallow* | 3.7 |
| Oil from oil seeds** | 4.7 to 17.5 |
| **Total Estimated Supply** | **8.3 to 22.6** |

* One-half of the estimated supply
**65,000 to 166,000 acres @ 72 to 106 gallon/acre

## V. MARKETING OPTIONS

Marketing, one of the most important aspects to the success of any business, is vital for a commercial biodiesel plant. Once the plant begins operation the products need to be moved without interruption. In addition to biodiesel, the plant will produce glycerin and, if the feedstock is from seed, meal. While a complete marketing analysis is beyond the scope of this document, it is critical that parties investigating the development of a commercial facility have a firm plan for the marketing of their products.

**Biodiesel Markets**

A growing number of firms market biodiesel nationwide as a replacement or additive to diesel fuel. An inherent advantage of biodiesel is selling to local markets, and it provides the best opportunity to get the highest price for the product. Idaho consumes about 1 million gallons a day of diesel. Table 7 shows the diesel consumed in Idaho by the type of use and the estimated diesel market in the study area. The estimated on-highway diesel use in the study area was estimated by averaging the percentage of the Idaho population in the study area, 42%, with the percentage of the Idaho registered vehicles in the study area, 38%, and using the equivalent gallons of diesel per person to add the estimated amount for Malheur County. The same percentage and procedure were used for all other uses except for farm and military consumption. Farm diesel use was based on the state average gallon per harvested cropland acre. Mountain Home Air Force Base is the principal military diesel user in the state and located within the study area. It should also be noted that diesel consumption at the air force base varies widely. Consumption in the three years prior to 2004 averaged about 3.75 million gallons a year, compared to the 62 thousand gallons shown in Table 8. The last two columns in Table 7 show the potential markets at 20% and 5% saturation. Based on these assumptions the potential market for biodiesel in the Treasure Valley ranges from 8 to 32 million gallons per year.

**Table 8 – 2004 Idaho Diesel Consumption & Estimated Biodiesel Markets**

| | ------------THOUSAND GALLONS ------------ | | | |
|---|---|---|---|---|
| **DIESEL USE** | **IDAHO* DIESEL USE** | **Treasure Valley DIESEL USE** | **Treasure Valley 20%** | **Treasure Valley 5%** |
| On-Highway | 238,093 | 100,728 | 20,146 | 5,036 |
| Off-Highway** | 35,574 | 15,050 | 3,010 | 752 |
| Industrial | 22,829 | 9,658 | 1,932 | 483 |
| Residential | 19,818 | 8,384 | 1,677 | 419 |
| Commercial | 19,171 | 8,110 | 1,622 | 406 |
| Farm | 63,126 | 5,904 | 1,181 | 295 |
| Railroad | 24,073 | 10,184 | 2,037 | 509 |
| Military | 62 | 62 | 12 | 3 |
| Other | 24 | 9 | 2 | - |
| **Totals** | **422,770** | **158,081** | **31,616** | **7,904** |

*Energy Information Administration, 2004.
**Off-highway use includes construction equipment, stationary generators, air compressors, logging equipment etc.

Federal and state programs, increases in the price of diesel, and growing public interest have resulted in a dramatic growth in the use of biodiesel during the past few years. The Energy Policy Act (EPAct), amended by the Energy Conservation Reauthorization Act of 1998, included biodiesel fuel as a way for federal, state, and public utility fleets to meet requirements for using alternative fuels. Pure biodiesel (B100) is considered an alternative fuel under EPAct. Lower-level biodiesel blends are not considered alternative fuels, but covered fleets can earn one EPAct credit for every 450 gallons of B100 purchased for use in blends of 20% or higher. In April 2000, Executive Order (E.O.) 13149 also directed federal fleets to reduce their consumption of petroleum by 20%. This Executive Order also required the use of alternative fuel in alternative fuel vehicles (AFV) purchased under EPAct (see the EPAct Alternative Fuels Web page).

Several other federal policies will affect the biodiesel market. The Energy Act of 2005 signed into law in August 2005 (Public Law 109-58), included a renewable fuels standard (RFS) that mandates 7.5 billion gallons of renewable fuel be incorporated in the national fuel pool by 2012. The primary focus of this mandate is ethanol but biodiesel is a qualifying fuel. Federal policy that is likely to have the biggest impact on the biodiesel market, however, is the Environmental Protection Agencies (EPA) rules, under 40 CFR Part 80, to reduce sulfur in diesel from 500 ppm to 15 ppm. Terminals have until September 1, 2006, and retailers will have until October 15, 2006, to complete their transitions to ultra-low sulfur diesel (ULSD). Since biodiesel effectively replaces sulfur and is more attractive in many respects to other additives to replace sulfur, this may be the single largest factor introducing biodiesel into the mainstream market.

Several state entities are also encouraging the biodiesel market. Beginning in early 2001, the Idaho Energy Division and Community Planning Association of Southwest Idaho (COMPASS) started the "Treasure Valley B20 Project" to help coordinate the commercialization of biodiesel with businesses and government agencies. Under the program the Energy Division pays any increased cost difference between diesel blended with 20-percent biodiesel (B20) and diesel fuel to allow fleets to test biodiesel in their operations and transition them into full scale B20 use. With the cooperation of southwest Idaho petroleum distributors, several fleets including school buses, trash-collecting companies, and the Idaho Department of Transportation began using B20 in early 2002. On April 15, 2003, the first public B20 biodiesel pump in Idaho was opened at Emerald Street and Five Mile Road in Boise. The station closed for reasons not related to biodiesel in 2004, but two card-lock Pacific Pride stations opened in Boise soon after. It is anticipated that public stations offering biodiesel in the Treasure Valley will be available soon. In March 2006 the Energy Division issued a statewide Request for Proposals offering $289,000 to help install biodiesel infrastructure. A Treasure Valley group, the Treasure Valley Clean Cities Coalition, was also formed to promote biodiesel use.

**Figure 12 - Idaho Department of Transportation, a Treasure Valley B20 Project partner, advertises using biodiesel.**

According to a survey conducted by the University of Idaho in 2003 and 2004, cost is the principle-marketing driver for acceptance of biodiesel in the Treasure Valley (Kinsey, 2004). Biodiesel does have benefits that make it attractive to many users. Other market drivers for biodiesel are:

- Non-Toxic, Biodegradable, Renewable
- Very Favorable Energy Balance (3.2 to 1)
- Air Quality Improvements
- Smoke & Odor Are Much Better
- Energy Independence
- Requires No Engine Modifications
- Can be Blended in Any Proportion with Diesel
- High Cetane Number & Excellent Lubricity
- Very High Flashpoint (>300$^0$F)
- Can Be Made From Recycled Restaurant Oils & Animal Fats

In addition to on-highway use, biodiesel can be used for home heating oil and boiler fuel. Using biodiesel as an additive to home heating oil has been a successful and growing trend in the mid-Atlantic and northeast United States. A registered heating fuel, known as “bioheat”, has 5% biodiesel meeting ASTM D6751 specifications, blended with No. 2 home heating oil.

**Factors Affecting the Acceptability of Biodiesel in Idaho**

There are various factors, which make the availability of biodiesel acceptable in Idaho. One such factor is the knowledge and awareness about biodiesel among the diesel and biodiesel customers in regions where biodiesel is available, which in turn contributes to biodiesel demand. A survey was developed and administered to gage the knowledge and perception of biodiesel by diesel and biodiesel customers. Forty percent of all customers surveyed had not heard of biodiesel and another 40% were participants in a biodiesel buydown program. Through analysis of the survey, it was determined that most people are not willing to pay much extra and may well not pay any premium to use biodiesel. Although participants agreed that biodiesel use would decrease demand of imported oil, is beneficial environmentally, could increase use of local agriculture, and potentially boost the economy of the state, these factors did not surpass the overlying issue of cost. *Kinsey, 2004*

## Glycerin

Biodiesel production generates glycerin, also known as glycerol or glycerine, as a byproduct of the transesterification reaction. Determining what should be done with the glycerin is one of the fundamental questions facing a potential biodiesel plant developer. Glycerin is used for many products. Table 9 shows the worldwide consumptions and uses of glycerin. Glycerin produced from the transesterification process contains methanol or ethanol, soap, catalyst and any impurities of the process. Before it can be sold in the glycerin market it must be purified. Equipment for refining glycerin is expensive and generally not justified for most biodiesel operations. There is also considerable risk since a large number of biodiesel plants can easily saturate the glycerin market as it has in Western Europe.

If the alcohol is removed from glycerol, which is relatively easy and cost-effective for a commercial biodiesel plant, it can be used as an additive in cow rations at the rate of about one pound per cow per day (Mann, 2005). The number of cattle in the Treasure Valley is provided on Table 10. Table 11 shows the glycerin production from a given plant size and number of cows that would be needed to use the subsequent glycerin production. From this it can be seen that the number of cows in the Treasure Valley is more than adequate for utilizing the glycerol as a cattle feed ration.

The impure glycerol could also be use in biomass combustion plants for heat and/or electric power. The energy content of glycerol is about 91,000 BTU per gallon as compared to No. 2 diesel at 140,000 BTU per gallon. In a 1 million gallon per year biodiesel plant 750,000 pounds of glycerin would be produced with a potential value of 21-cents per pound, based on heating oil value of $2.50 per gallon.

**Table 9 - Production, Consumption, and Uses of Glycerol, 2001***

| | --------- THOUSAND TONS ------- | | | |
|---|---|---|---|---|
| **USES** | **U.S.** | **EUROPE** | **JAPAN** | **TOTAL** |
| Annual capacity | 169,000 | 315,000 | 59,000 | 543,000 |
| Production | 159,000 | 247,000 | 53,000 | 459,000 |
| Consumption | | | | |
| Personal/oral care | 75,000 | 46,000 | 15,500 | 136,500 |
| Pharmaceuticals | 14,000 | 24,000 | 23,000 | 61,000 |
| Food/beverages | 42,000 | 27,000 | | 69,000 |
| Polyether polyols | 17,000 | 33,000 | 6,000 | 56,000 |
| Tobacco | 22,000 | 15,000 | 5,000 | 42,000 |
| Alkyd resins | 6,000 | 17,000 | 7,500 | 30,500 |
| Other | 13,000 | 79,000 | 29,000 | 121,000 |

* Source: Chemical Economics Handbook

**Table 10 - Cow, Calf, & Cattle Inventory in the Study Area**

| Area | Inventory |
|---|---|
| Southwest Idaho | 620,000 |
| Malheur County, OR | 215,000 |
| **Total** | **835,000** |

Source: Idaho Agricultural Statistics 2004

**Table 11 - Glycerin Production vs. Plant Size and Required Market as a Ration Component***

| Plant Capacity (million gal) | Glycerin (Million lb.) | Required Cows |
|---|---|---|
| 0.5 | 0.37 | 1,000 |
| 1 | 0.75 | 2,000 |
| 4 | 3 | 8,200 |
| 12 | 9.0 | 24,700 |
| 18 | 13.5 | 37,000 |

*Assumes glycerin as ration component of 1 lb/day/cow.

**Oil Seed Meal**

If oil seeds are crushed to produce oil for biodiesel plant production a meal will be left after removing the oil. Meal from seed crops grown in the Northwest has the potential to be a valuable commodity but the markets have not been established. Meal can be used as soil amendments, soil fumigants, pesticides, herbicides, fertilizers, and food additives for human and animal consumption. The value of the meal for many of these applications is high, but several steps need to be taken in order to realize this value. Mustard and rape meal, for instance, has not gone through the testing and labeling required by the Environmental Protection Agency as a soil amendment or pesticide.

Since there is a large number of livestock in southern Idaho and the Treasure Valley, livestock feed is the most likely market for oil seed meal. Meal from crushing facilities contains residual oil, protein, and fiber. Safflower seed meal, for instance, contains about 24 percent protein, 5 to 10 percent oil depending on the efficiency of the expeller, and about 50 percent fiber (Thomas Jefferson Agricultural Institute, 2005). Table 12 shows the suitability of the potential oil seed crops for livestock feed and the estimated value. The value of the meal for feed is based on the protein content. Based on this, and using soybean meal as the basis, safflower meal would be worth about $120 per ton using Portland, Oregon, prices on August 17, 2005. Meals high in glucosinolates are not suitable for feed. Table 13 shows the meal production from various biodiesel plant sizes, and the number of livestock that would be needed to support the plant assuming five pounds per day per cow.

**Table 12 - Byproduct Utilization: Oil Seed Meal Value**

| Oil Seed Crop | Suitable for Feed | Protein (%) | Value ($/Ton)* |
|---|---|---|---|
| Safflower | Yes | 25 | 120 |
| Sunflower | Yes | 50 | 239 |
| Yellow mustard | ** | | |
| Canola | ** | 36 | 172 |
| Rapeseed | ** | 36 | 172 |

*Based on the price for soybean meal with 47% protein using the Portland, Oregon price in 8/17/2005 of $225 per ton.
** Depends on the glucosinolate content.

**Table 13 - Oil Seed Meal as a Ration & Cows Required**

| Plant Capacity (Million Gallon) | Meal Production (Tons) | Dairy Cows Required* |
|---|---|---|
| 0.5 | 3,300 | 3,600 |
| 1.0 | 6,700 | 7,300 |
| 4.0 | 26,700 | 29,200 |
| 12 | 80,000 | 87,000 |
| 18 | 120,000 | 132,000 |

* Assumes 5 lb/day/cow in ration.

## VI. PLANT COSTS & REVENUE

### Capital Costs

The process equipment for producing biodiesel is a series of tanks, pipes, pumps, heat exchangers, condensers, and valves. Several companies offer turnkey biodiesel plant design and installation services. For plants with capacities less than 10 million gallons of biodiesel per year there are also companies offering skid mounted modular units. Developers should investigate the process, sources, and suppliers carefully to assure a quality installation and fully investigate the success of the contractor's previous installations. Table 14 shows the estimated general cost of various plant sizes using contractors that have a history of successful installations with a process that has been proven. This cost does not include the cost of land, buildings, utility installation, wastewater treatment, or rail spur development. Actual capital costs will be influenced by a variety of site-specific factors and the variety and quality of feedstocks. Processing multiple feedstocks will be more costly than processing oil from a single source.

**Table 14 - Estimated Capital Cost for a Biodiesel Facility**

| Annual Production (Million Gallons) | Capital Cost per Gallon |
|---|---|
| 0.5 | $2.00 |
| 1.0 | $2.00 |
| 5.0 | $1.25 |
| 20 | $1.00 |

The transesterification process is seemingly simple and many developers have and are putting together their own team of experts to design and install the plant equipment. While this may significantly reduce the capital cost of the plant, it is also likely to cause significant delays in plant start-up and can result in an inefficient plant that is not competitive.

### Operation Costs

The cost of producing biodiesel will vary with the size of the facility and the feedstock. Feedstock is by far the largest cost of producing biodiesel. If the cost of refined oil were $0.26 per pound, the value of the virgin oil in the finished product would be about $1.95 per gallon ($.026 x 7.5 lb/gal.). In contrast, if yellow grease was purchased at the average Pacific Northwest price of $0.11 per pound (Figure 8), the cost of the feedstock in the finished biodiesel would be about $0.83 per gallon. However, the additional treatment required for yellow grease would add to the costs.

The cost of producing biodiesel from oil seeds grown in the Treasure Valley would depend on the price paid to the producer, freight, cost of expelling the oil from the seeds, and the efficiency of the expeller. Assumptions used to estimate operation costs are shown in Table 15.

**Table 15 – Processing Cost Assumptions**

| PROCESS | COST ASSUMPTION |
|---|---|
| Used Oil | $0.11 per Pound |
| Tallow | $0.112 per Pound |
| Oil Seed* | $0.151 per Pound |
| Crushing & Filtering | $50.00 per Ton |
| Methanol | $0.14 per Gal. of Biodiesel |
| Catalyst** | $0.073 per Gal. of Biodiesel |
| High FFA Processing | $0.06 per Gal. of Biodiesel |
| Freight | $0.05 per Gal. of Biodiesel |
| Cost of Plant Operation** | $0.20 - $0.30/Gal of B100 |

*Ave. 2004 canola price plus $.04/lb for cleaning & handling.
**From Van Gerpen et.al., 2005

The total cost for operating different size plants using a mixed feedstock are shown in Table 16. The table uses 0.5 million gallons of yellow grease and 3.5 million gallons of tallow, plus an oil seed crop with a 2,200 pounds per acre yield, 40 percent oil content and a seed press efficiency of 90 percent. The costs for analytical services and marketing are not included in the table. Results show there is a significant increase in the feedstock costs using virgin oil. The cost of using virgin oil would be reduced a small amount by not needing further treatment for high FFA's and some reduction in capital cost. There are also incentives discussed further in this section that make it more attractive for virgin oil.

**Table 16 - Processing Costs ($) as a Function of Feedstock and Plant Size**

| Feedstock | Yellow Grease (YG) | YG + Tallow (T) | YG +T + OIL from 65,000 A @2200 LB/A | YG +T + OIL from 166,000 A @2200 LB/A |
|---|---|---|---|---|
| **Plant Capacity** | **0.5 Million Gallon** | **4 Million Gallon** | **11 Million Gallon** | **21.5 Million Gallon** |
| Feedstock | $375,000 | $3,315,000 | $24,908,000 | $58,460,000 |
| Methanol | 70,000 | 560,000 | 1,521,000 | 3,014,000 |
| Catalyst | 36,000 | 292,000 | 793,000 | 1,572,000 |
| FFA Treatment | 30,000 | 240,000 | 240,000 | 240,000 |
| Freight | 25,000 | 200,000 | 543,000 | 1,076,000 |
| Crushing | -- | -- | 3,575,000 | 9,130,000 |
| Operation | 150,000 | 1,132,000 | 2,705,000 | 4,306,000 |
| **Total Cost** | $686,000 | $5,739,000 | $34,285,000 | $77,798,000 |
| Cost/Gallon | $1.37 | $1.43 | $3.15 | $3.61 |

*Cost of analytical services and marketing are not included.

**Revenues**

In addition to biodiesel, the plant will produce glycerin and, if the feedstock is from seed, meal. The assumptions for biodiesel and byproduct revenues are shown in Table 17. The income streams, costs and profit for the different sized mixed feedstock plants are shown in Table 18. Table 19 shows the income streams, costs and profit for an 11 and 21.5 million gallon per year plant just using virgin oil as the feedstock. Table 20 shows a sensitivity analysis for processing cost and net profit or loss per gallon as a function of seed cost per pound.

**Table 17 - Biodiesel & Byproduct Revenue Assumptions**

| Products | Revenues |
|---|---|
| Biodiesel | $2.20/gal |
| Glycerin | $0.05/lb |
| Meal | $125/ton |

It can be seen that the low cost of yellow grease and tallow result in a considerably lower cost for biodiesel. There is, however, a limited amount of yellow grease and tallow available. Production from oil seed crops must be used for larger plants. As a result of this study, an Excel spreadsheet is now available where potential developers can use different assumptions for plant assessment. The spreadsheet is available at www.biodieseleducation.org.

**Table 18 – Mixed Feedstock Income, Cost & Profit as a Function of Plant Size***

| Feedstock | Yellow Grease (YG) | YG + Tallow (T) | YG +T + OIL from 65,000 A @2200 lb/A | YG +T + OIL from 166,000 A @2200 lb/A |
|---|---|---|---|---|
| **Plant Capacity** | **0.5 Million Gallon** | **4.0 Million Gallon** | **11 Million Gallon** | **21.5 Million Gallon** |
| Biodiesel | $1,100,000 | $8,800,000 | $23,900,800 | $47,365,120 |
| Glycerol | $500 | $20,000 | $54,320 | $107,648 |
| Meal | -- | -- | $5,720,000 | $14,608 |
| **Total** | $1,02,500 | $8,820,000 | 29,675,120 | $62,080,768 |
| Income/Gallon* | $2.22 | $2.21 | $2.73 | $2.88 |
| Cost/Gallon | $1.37 | $1.44 | $3.16 | $3.61 |
| Profit/Gallon | $0.83 | $0.77 | ($0.42) | ($0.73) |

* No program incentives, analytical services or marketing costs are considered.

**Table 19 – Plant Size vs. Income, Costs, & Profit with Virgin Oil Feedstock***

| Feedstock | 104,000 Acres of Oil Seed | 203,700 Acres of Oil Seed |
|---|---|---|
| **Plant Capacity** | **11 Million Gallon** | **21.5 Million Gallon** |
| Feedstock | $34,615,240 | $67,669,140 |
| Methanol | 1,540,493 | 3,011,501 |
| Catalyst | 803,257 | 1,570,283 |
| FFA treatment | 0 | 0 |
| Freight | 550,176 | 1,075,536 |
| Crushing | 5,731,000 | 11,203,500 |
| Operation | 2,739,876 | 4,302,144 |
| **Total Cost** | $45,980,042 | $88,832,103 |
| Cost/Gallon* | $4.18 | $4.13 |
| Income ($/Gallon) | $3.04 | $3.04 |
| Profit ($/Gallon) | -$1.14 | -$1.09 |

* No program incentives, analytical services or marketing costs are considered.

**Table 20 – Sensitivity Analysis* for Processing Cost and Net Profit Or Loss per Gallon as a Function of Seed Cost per Pound****

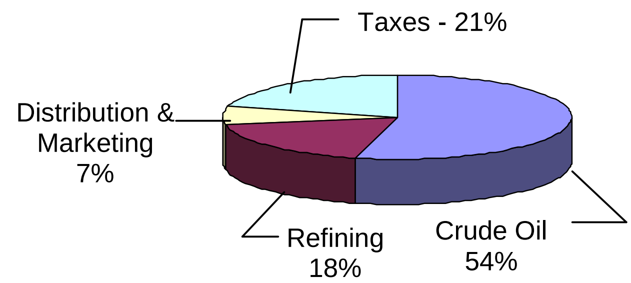
| Seed Cost Per Pound*** | 11 Million Gallon/Year Plant | | 21.5 Million Gallon/Year Plant | |
|---|---|---|---|---|
| | Total Cost Per Gallon | Profit or Loss Per Gallon | Total Cost Per Gallon | Profit or Loss Per Gallon |
| $0.06 | $3.12 | $0.08 | $3.07 | $0.03 |
| $0.08 | $3.53 | ($0.49) | $3.48 | $0.45 |
| $0.10 | $3.95 | ($0.91) | $3.90 | ($0.86) |
| $0.12 | $4.37 | ($1.33) | $4.32 | ($1.28) |
| $0.14 | $4.78 | ($1.74) | $4.73 | ($1.70) |
| $0.16 | $5.20 | ($2.16) | $5.15 | ($2.11) |
| $0.18 | $5.62 | ($2.58) | $5.57 | ($2.53) |
| $0.20 | $6.03 | ($2.99) | $5.98 | ($2.95) |

* Based on data used for Table 15 with varying seed cost.
** No program incentives, analytical services or marketing costs are considered.
*** Includes $0.04 per pound for cleaning and handling

## Tax and Incentives

As indicated in the Marketing Options chapter, on-highway diesel is by far the largest market for biodiesel. With current incentives it is also the most price competitive with diesel. According to the Energy Information Administration, the price breakdown for diesel at the pump is 72 percent for the crude oil and refining, 7 percent for marketing and distribution, and 21 percent for taxes. The federal excise tax on on-highway fuel is 24.4 cents per gallon. The State of Idaho adds another 25 cent per gallon. There are both federal and state incentives that encourage biodiesel and are critical for making a commercial biodiesel plant feasible. Idaho will forgive the tax for the biodiesel portion of up to a 10% blend.

**Figure 13 - On-Highway Diesel Cost Breakdown**




Source: Energy Information Administration, 2005

The Energy Act of 2005, which became Public Law 109-58 on August 8, 2005, included, among other things, a federal excise tax credit and a small agri-biodiesel producers tax credit. The IRS form for declaring these credits is 8864. The federal excise tax credit equates to one cent per percent of biodiesel in a fuel blend made from virgin oils and animal fats, and one-half penny per percent for recycled oils. This one-dollar per gallon tax credit for biodiesel made from virgin oil is clearly the key factor in bring commercial biodiesel plants on-line today. Form 8864 is used to file for the credits and the IRS issued a guidance document on August 1, 2005, Notice 2005-62, which provides guidance on how the law will be applied. A key provision of the IRS requirements is that producers must certify the fuel meets ASTM standards. The small agri-biodiesel producers tax credit establishes a 10-cent per gallon tax credit for up to 15 million gallons of production of annual production. Agri-biodiesel means biodiesel derived for virgin oils and animal fats. Both tax credits are effective until the end of 2008.

The Farm Security and Rural Investment Act of 2002 included a provision for buying down the cost of feedstocks to increase production of renewable fuels. Under this program the Commodity Credit Corporation (CCC) pays market prices for the feedstock to biodiesel producers. In 2004, for instance, a 5 million gallon per year biodiesel plant using canola oil for feedstock would be paid the market price for up to about 15.4 million pounds of canola seed. The CCC program is only funded through 2006 and has not been funded to authorized levels in recent years with reimbursement at about 35 percent of the calculated amount.

The State of Idaho also has an excise tax credit for blends of biodiesel up to 10 percent (Idaho Statutes, Title 63, Chapter 24). Any portion above a 10 percent blend must pay the existing tax rate. The credit amounts to 10 percent of the state fuel tax, or 2.5 cents per gallon, for a 10% biodiesel blend with diesel (B10) and above. For instance, a blend of 50 percent biodiesel and 50 percent diesel still only gets the 2.5 cents per gallon credit. This credit is paid to the fuel distributor.

## VII. PLANT SITE SELECTION, PERMITS & REGISTRATIONS

**Site Considerations**

Zoning and building impediments, transportation access, land cost, feedstock and market proximity, and utility, wastewater treatment, and water availability are all important issues to consider in locating a biodiesel plant. The purchase or long-term lease of existing buildings may reduce costs in both time and money and may be preferable in all but the largest plants. Zoning permits, discussed in detail below, would be for commercial or light industry. Good road and, likely, rail access is a key factor for selecting a site. Interstate 84 runs across the study area from east to the northwest corner and there is a good network of highways adjacent to rail lines. Rail access may not be necessary for plants less than 5, perhaps even 10 million gallons per year but limit feedstock flexibility and markets outside of the local area. Union Pacific Railroad runs through southern Idaho and Idaho Northern & Pacific Railroad runs within the study area as shown in Figure 14. It might also be possible for the Northern & Pacific to help upgrade a rail siding or spur.

The electrical demands for a biodiesel facility are approximately 0.1 kW per gallon of production or about 876,000 kWh per year per million gallons of annual production. All of the study area is served by Idaho Power Company although there are no power lines in much of the southern half of Owyhee County. Current electrical rate for Idaho Power small commercial customers is 7-8-cent per kWh or $60,000 to $70,000 per year per million-gallon annual production. The service needs to be 3-phase at 480 volts and Idaho Power should be consulted for locations with adequate service. Intermountain Gas serves the study area where natural gas service is available.

Wastewater from the facility will likely need to be treated at the nearest water treatment facility. Much of the study area is under a moratorium for new water rights and the facility will likely need to be connected to the local water system. Proximity to feedstocks, markets, livestock operations, labor force, medical facilities, and airports may also influence site selection.

**Local, State and Federal Permits**

Permitting can be one of the biggest obstacles to the development of any industrial plant. In Idaho the permitting required for developing a biodiesel production facility should not be a formidable task. It should also not be considered trivial. Several of the most complex regulations are intended to avoid needing a permit by minimizing health, safety and environmental risks. Since laws and regulations are continually changing, the following discussion should be considered preparatory with standard circumstances normally associated with building a biodiesel production facility.

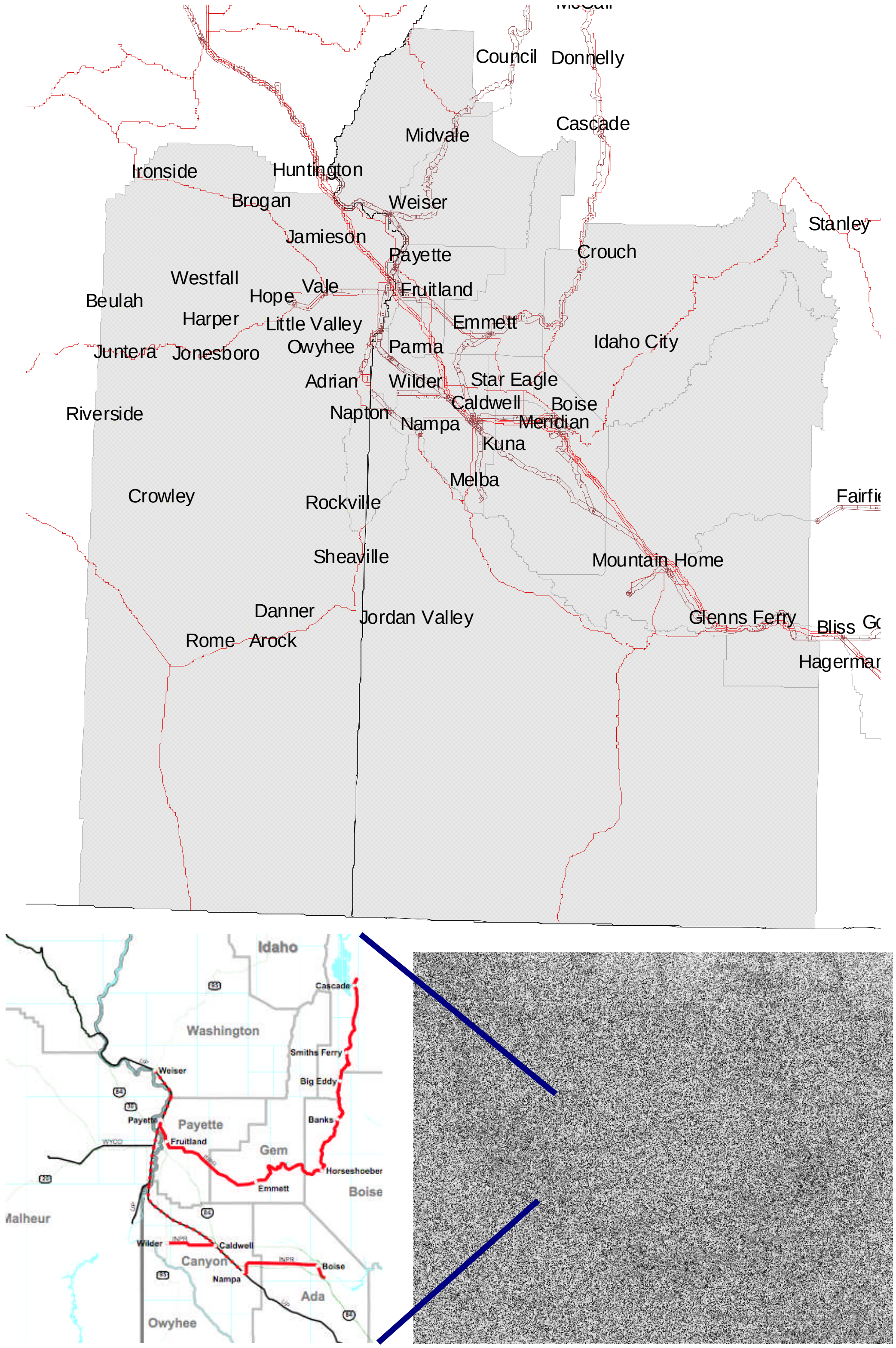



**Figure 14 - Idaho Northern & Pacific Railroad Operates Within The Study Area & Union Pacific Main Line Crosses Southern Idaho**

***Zoning and Building Permits***

In Idaho, the local zoning permit is the primary regulatory permit needed to construct a biodiesel production facility. It can also evolve into a monstrous exercise in time, money and frustration. Idaho Code 67-6511 gives the county or municipality legal authority to control the use of property and physical configuration of development upon tracts of land within their jurisdiction. The zoning process must be based on comprehensive plans and are enacted for the protection of public health, safety and welfare. The zoning and building permits requirements vary widely within the state and may be the deciding factors in selecting a site.

In most cases, the project development team should include an architectural or engineering firm familiar with obtaining zoning and building permits in the area. This will save time and money. Potential developers will first need to meet with the local Fire Marshal, transportation authority and planning and zoning officer and be prepared to provide and/or discuss information listed in the box shown below.

Normally this information is refined during the zoning process to conform to the local requirements. Depending upon the jurisdiction there may be various fees, prior approvals by various agencies like the Fire Marshal and local highway authority, and a hearing before the planning and zoning authority. Once there is zoning compliance and approval, potential developers must also obtain building permits from the local planning authority. Building Codes are collections of regulations that pertain to specific subjects such as designing, constructing or remodeling of buildings. City and County Building Codes are adopted locally by ordinance but must be recognized by the Idaho Division of Building Safety. Adherence with the National Fire Code, which is administered by the local Fire Marshal, will likely influence the design of the facility.

**Information to Develop for Planning & Zoning**

- Legal description and Assessor Account Number
- Current zoning information and occupancy classification
- Building plans and construction type(s)
  - Electrical, mechanical and plumbing plans
  - Facility layout and floor areas
- Plot and Site plans
  - Topography, property lines and distances
  - Building(s) and transportation layout
  - Sewer, water line, electrical service, and fire hydrant locations
  - Landscape plan
- Operation plans, including:
  - Process, quantities of materials, hazardous materials and MSDS sheets
  - Transportation plan
  - Fire plan with access and turn around
  - Water, sewage and solid waste plans
  - Drainage, erosion and sediment control plans
- Building and Fire Code evaluation
- When in a flood plain, an Elevation Certificate

***Storage Tanks***

Storage tanks used for commercial biodiesel production facilities are subject to federal regulations. In Idaho, the EPA enforces storage tank regulations which are divided into above ground tanks and underground tanks. Above ground storage tanks are regulated by the EPA in accordance with the Clean Water Act, as amended by the Oil Pollution Act. The text of the regulation is found at 40 CFR part 112. This regulation establishes requirements for facilities to prevent oil spills from reaching surface waters. The rule applies to facilities that have an aggregate storage capacity greater than 1,320 gallons or a completely buried storage capacity greater than 42,000 gallons; and could reasonably be expected to discharge oil in quantities that may be harmful into surface waters. The regulations apply specifically to a facility's storage capacity, regardless of whether the tank(s) is completely filled.

The EPA does not permit or register regulated facilities but has the authority to penalize owners if they are not complying with the regulations. Regulated facilities are required to have a fully prepared and implemented Spill Prevention, Control, and Countermeasure, or SPCC Plan (SPCC rule) and a Facility Response Plan (FRP). A licensed professional engineer must certify the SPCC Plan. The SPCC Plan is required to address the facility's design, operation, and maintenance procedures established to prevent spills from occurring, as well as countermeasures to control, contain, clean up, and mitigate the effects of an oil spill that could affect navigable waters. In addition, facility owners or operators must conduct employee training on the contents of the SPCC Plan. An FRP is a plan for responding, to the maximum extent practicable, to a worst case discharge of oil and to a substantial threat of such a discharge. The Plan also includes responding to small and medium discharges as appropriate. Administration of the regulations is done through the Boise office and further information can be obtained at www.epa.gov/oilspill.

Underground storage tanks (UST), or tanks that are at least 10% buried, that store petroleum products or other hazardous liquids must be registered with the EPA, using EPA Form 7530-1, and meet leak detection requirements. Local EPA Emergency Response and Hazardous Waste personnel conduct inspections of underground storage tank facilities. The DEQ Waste Management and Remediation Division offers technical assistance but it does not have storage tank enforcement authority. DEQ does have the authority to require investigations and cleanups of releases from leaking underground storage tanks (LUST). Federal regulations of UST can be found in 40 CFR Parts 280 and 281.

Federal law requires owners to carry pollution liability coverage for regulated USTs to demonstrate they have the resources to pay for cleanup and compensatory costs. Idaho's Petroleum Storage Tank Fund (PSTF) operates as a nonprofit insurance company and is responsible for administering the Idaho Petroleum Clean Water Trust Fund. The petroleum liability insurance policies issued to owners and operators of regulated USTs through the PSTF satisfies the federal financial responsibility requirements. The PSTF also provides insurance coverage to owners of all eligible unregulated above ground petroleum storage tanks. Further information on the Idaho State Insurance Fund can be found at www.idahosif.org.

### *Hazardous Materials Permitting*

A biodiesel production facility will involve the handling of hazardous material such as methanol and strong bases. A commercial production facility will have a quality control laboratory staffed by personnel trained in laboratory practices and responsible for assuring compliance with various laws and regulations related to hazardous materials. The provisions of OSHA require, among other things, hazardous materials training, Material Safety Data Sheets (MSDS) for all chemicals used in the facility, and numerous employee safety requirements.

The Resource Conservation and Recovery Act (RCRA) is the federal law regulating the generation, handling, storage, treatment, and disposal of hazardous wastes. In Idaho, DEQ's Waste Management and Remediation Division administers the RCRA regulations. Under these regulations businesses are responsible for determining whether any wastes generated are hazardous and the amount. With some exceptions, facilities that treat, store or dispose of hazardous wastes are subject to the permitting process. The degree to which a generator of hazardous waste is regulated depends on how much waste is produced every calendar month.

In general, a biodiesel production facility should not be a hazardous waste generator. A facility that generates a small amount of hazardous waste may fall into the least regulated category of hazardous waste generator called the Conditionally Exempt Small Quantity Generator (CESQG). CESQGs generate less than 100 kg (220 pounds) of hazardous waste per month, or less than 1 kg (2.2 pounds) of acutely hazardous waste, and are subject to a limited, less stringent set of generator waste management standards. CESQGs are required to keep track of the amount of hazardous wastes generated and stored on-site each month, have on-site documentation that the facility is within the limits for this classification and properly dispose of the wastes. The facility may also wish to obtain an EPA Identification Number to track quantities, types, and movement of hazardous wastes the facility generates.

Another key issue under RCRA is the designation of "waste." Raw materials in storage are not waste and material recovered as part of the process are not waste unless so designated. Recovered co-products are not waste if they are to be used elsewhere in processing or legitimately sold to another entity. Materials cannot be stockpiled and must have a "reasonable expectation" of use within the facility within specified time periods. RCRA provides a strong incentive to operate in such a way as to avoid being required to have a permit. The permitting process can take years to complete due to the technical standards that must be met, and requires considerable reporting once the permits are issued.

Operation of a biodiesel production facility will require submittal of "Tier II Forms" with a listing of potentially hazardous chemicals stored on-site under the Emergency Planning and Community Right to Know Act (EPCRA). EPCRA, or Right-to-Know, provides community access to information about chemical hazards and facilitates emergency response plans by state and local governments. Forms are submitted annually to the Idaho Department of Homeland Security (also identified as the State Emergency

Response Commission or SERC), the Local Emergency Planning Committee (LEPC) and the Fire Marshall. Tier II Forms require basic facility identification information, employee contact information for both emergencies and non-emergencies, and information about chemicals stored or used at the facility. Additional submittals are required if chemicals in excess of "threshold" amounts are used or stored. Complete information on Tier II reporting is available at www.bhs.idaho.gov.

***Air Quality Permit(s)***

In addition to the EPA Fuel Certification previously discussed, any business or industry (source) in Idaho that emits, or has the potential to emit, pollutants into the air are required to have an air pollution control permit. Transportation, handling and storage of agricultural oilseed feedstock are potential sources of particulate matter emissions. If the facility design includes combustion as the source of process heat, the facility may be required to install equipment to control gaseous and particulate matter emissions.

The Air Quality Division of the Idaho Department of Environmental Quality (DEQ) is the state agency delegated to issue air quality permits in Idaho. Development of a biodiesel production facility may require a Permit to Construct (PTC) or a Tier II Operating Permit. A PTC is required prior to construction or modification of stationary sources, such as buildings, structures, and other installations that emit, or may emit, pollutants into the air. A PTC is also required for certain portable equipment such as generators. PTC applicants are required to submit the following information:

- A complete description of the proposed process from raw material feed to final product output, including operating design capacity, hours of operation, and feed material characteristics.
- Manufacturers' guarantees for stated control efficiencies of all control equipment.
- Emission estimates for all regulated air pollutants with supporting calculations, assumptions, or manufacturer guarantees for emission control devices.
- A description of potential fugitive emissions.
- A narrative description of the facility and the process from feed material in to final product output.
- A process flow diagram.
- A scaled plot plan clearly showing property boundaries, building, and stack locations.
- Stack height, diameter, orientation (e.g., vertical or horizontal), gas flow rate, and temperature for each emission point.
- Any other information necessary to determine which regulations affect the stationary source and any information needed to determine if the source will continuously comply with all applicable regulations (including federal).

An application fee of $1,000 is required with any PTC application. A PTC processing fee is also required and is dependant upon the quantity of permitted emissions.

DEQ may also require an operating permit. A Tier II Operating Permit is required for existing buildings, structures and installations that emit or may emit small amounts of pollutants. For example, DEQ might take this action as part of a State Implementation Plan designed to prevent further deterioration of air quality and to bring an area of the state back into compliance with the National Ambient Air Quality Standards. Tier II permits also may be issued to authorize an alternative emission limit for a particular emissions unit or units within a facility. All information submitted to DEQ must be certified by a responsible official to be true, accurate, and complete. Further air quality permit information and applications are available at the DEQ offices and at their website, www.deq.idaho.gov.

***Miscellaneous***

Compliance with other local, state, and federal regulations may be necessary depending on the facility size, specific location, process and specific circumstances. The Idaho Small Business Development Center offers free assistance to small businesses on environmental issues, regulations and OSHA compliance obligations through its Environmental Solutions program. Help is available by phone, email, or appointment to answer questions, solve problems, and provide guidance on a one-on-one basis. Further information can be found www.idahosbdc.org.

**Registration, License and Certification**

All biodiesel businesses, small and large, need to be aware of the fuel distributor registration and licensing requirements and certification with the Environmental Protection Agency.

***Fuel Distributor Registration and License***

A blender, producer or importer of biodiesel must be registered with the IRS using Form 637. To become registered is a time consuming process and plans should be made accordingly so that production can commence when the construction is finished. Otherwise the plant will sit idle until the registration is approved. Form 720 is the quarterly excise tax return, which is used to report and pay federal excise tax.

Idaho Code Sections 63-2433 and 63-2443 make it unlawful to act as a fuel distributor without a valid fuel distributor license. The Idaho State Tax Commission issues fuel distributor licenses. License application forms and bonding requirements are available at the Tax Commission office or on the internet at: www.tax.idaho.gov. A fuel distributor license requires a bond equal to the amount of fuels tax that would be due to the state for a 60-day period. The minimum bond amount is $1,000 and the maximum bond amount is $200,000. A fuel distributor remits fuel taxes to the state monthly on a Form 1450. If an individual produces biodiesel for personal use only, the individual is required to file a Form 75 and pay the Idaho fuels tax due on the biodiesel.

Idaho Code Section 63-2425 makes it unlawful to operate registered motor vehicles on Idaho's public highways with fuel that has not been taxed. Dyed diesel fuel that is used to operate stationary engines and unlicensed farm equipment is exempt from the Idaho fuels tax. The use of dyed diesel fuel in most licensed vehicles and in unlicensed vehicles equipped for highway use is prohibited by federal and state law. This includes registered vehicles that never leave private property or vehicles that are operated entirely on job sites or Forest Service roads. Even the occasional use of dyed fuel will contaminate the vehicle's fuel tank and is against the law. It should also be noted biodiesel is subject to the federal excise taxes and federal law prohibits the hand-dyeing of biodiesel to make the fuel nontaxable fuel.

***EPA Certification***

The Clean Air Act (CCA) authorized Environmental Protection Agency (EPA) to establish National Ambient Quality Standards to limit air pollutants. EPA subsequently promulgated strict rules for the amount of carbon monoxide, unburned hydrocarbons, oxides of nitrogen, and particulate matter that an engine is allowed to emit. Under sections 211(b) and 211(e) of CCA, EPA requires producers of fuels and fuel additives intended for use in motor vehicles to register their fuel. Fuels were then broken into baseline fuels, non-baseline fuels and atypical fuels. Diesel is the baseline fuel. Non-baseline is fuel that contains higher oxygen than diesel and is not a fossil fuel. Atypical is all other fuels.

Although emissions from biodiesel are well established, the EPA ultimately determined, with reasoning that is not clear, that biodiesel is an atypical fuel and is therefore subject to the strictest requirements of registration. Under these requirements biodiesel producers can either conduct emissions studies that will cost millions of dollars, or participant in a group of manufactures of the same or similar fuel. The National Biodiesel Board (NBB) is currently the only organization that has submitted emission testing results and subsequently received EPA certification acting as a manufacturers' group for biodiesel. The National Biodiesel Board is given the authority to recover the costs of the testing and submission of the application from the manufactures of biodiesel the National Biodiesel Board has implemented a biodiesel manufactures registration process. To become a member of the National biodiesel Board, interested parties should contact them at 1-888-BIODIESEL or at NBB's website www.NBB.org.

## VIII. CONCLUSIONS & RECOMENDATIONS

The Treasure Valley as defined in this report is the nine county area of southwest Idaho and eastern Oregon with a population of approximately 580,000 and 1.1 million acres of cropland. The major findings of this study as related to production and marketing of biodiesel in the study area are listed below and recommendations follow.

**Conclusions**

1. This analysis shows that the feedstocks, resources, and markets are available within the study area to support a biodiesel industry. While the study includes 0.5 to 22 million-gallon scenarios, the greatest potential exists in the 5 to 8 million-gallon range. The potential for importing feedstock and marketing outside the study area is not considered.

2. The estimated available feedstock from used oils included 0.3 to 0.5 million gallons of yellow grease, 3.7 million gallons from tallow, and 0.2 million gallons from food processing.

3. Oil available from oil seed crops is highly dependent on crop rotation strategies and estimates of potential yield. Adequate information on oil seed production under irrigation is lacking. Therefore, the estimates of potential oil could be as low as 4.7 million gallons (65,000 acres) and as high as 17.5 million gallons (166,000 acres).

4. The state agricultural order in Idaho may significantly limit the potential production of oil from brassicas such as yellow mustard, canola and rapeseed.

5. Potential oil seed crops other than brassicas include sunflower and safflower. There may be other crops that could be adapted but even for these agronomic information has not been adequately developed. Most of the information is from individual growers or from other regions of the country.

6. Potential market for biodiesel is about 33 million gallons at a 20 percent biodiesel: diesel blend ration. A more realistic estimate would be 8 million gallons, which is equivalent to a 5 percent blend.

7. For each million gallons of biodiesel produced from oil seeds there would be approximately 6,700 tons of meal produced requiring a market, if used for dairy cow feed, of 7,300 cows. There are more than sufficient cows in the study area to utilize the meal, however, the market would need to be developed.

8. For each million gallons of biodiesel, a market must also be found for 750,000 pounds of glycerol.

9. The estimated capital cost of a biodiesel plant is dependent on size and is approximately $2 per gallon plant size for a 0.5 million-gallon plant down to about $1 per gallon of plant size for a 20 million gallon plant. This does not include a crushing unit for the oilseeds or facilities for glycerin purification.

10. Profit from a biodiesel plant is feedstock dependent with potential profit from yellow grease highest followed by tallow and virgin oils. It is assumed a large plant would utilize a mix of these oils to meet plant-operating requirements.

11. Business plans must include provisions for required local, state, and federal permits and taxes.

12. Biodiesel producers should become familiar with state and federal biodiesel incentives, which significantly impact profitability. These change and are not guaranteed for the long term, therefore, the impact must be carefully considered when planning a biodiesel facility.

13. The most desirable location for a biodiesel plant is dependent on size. When selecting a site carefully consider the available utilities, transportation, environmental impacts and potential for expansion. There is significant advantage for larger plants to be on a rail spur and several potential sites exist in the study area.

**Recommendations**

1. This study provides an overview of the issues related to developing plans for a biodiesel plant. Every specific plant must develop their own detailed business and process plan.

2. In the planning stage, adequate time and resources must be allowed for the permitting process.

3. Those planning to use oilseed crops grown in the study area need to develop agronomic data related to the specific crops selected. They should also check with the state departments of agriculture for any restrictions and or regulations relating to these crops.

4. While the data presented suggest an adequate market for biodiesel, the actual market based on public acceptance has not been assessed.

5. State and federal incentives are currently favorable to biodiesel, however, the possibility that they may sunset may limit the ability of biodiesel producers to obtain long term funding. Future legislation should have provisions to encourage investments in these enterprises for the long term.

6. Each biodiesel producer must make provisions for quality control and required testing to assure that the fuel meets ASTM specifications. This may require an analytical lab as part of the plant, contracting with an existing laboratory, or a combination of the two.

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