

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

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Biodiesel As An Alternative to Diesel Fuel



- Invention of the Diesel Engine 1897
- Alternative Fuels
 - Environmental Concerns
 - Energy Shortages

Objectives

- Local sources of feedstocks
 - Oil
 - Alcohol
 - Catalyst
- Identify Marketing Options
 - Fuel
 - Glycerin
 - Meal
- Biodiesel Plant site Requirements
- Constraints for Biodiesel Plant
 - Economic
 - Environmental
 - Policy
 - EPA Fuel Certification

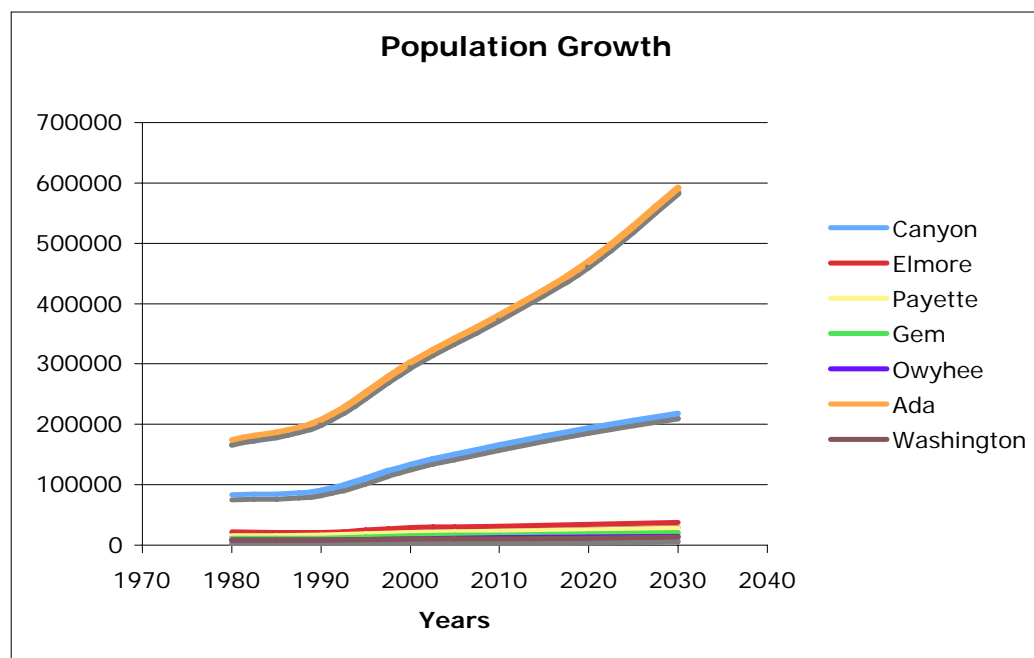
Biodiesel Technology

- Multiple technologies
- Commercial processes to produce an ASTM standard Biodiesel may be proprietary
- Any processor must anticipate the analytical requirements to assure ASTM standard compatibility

Greater Treasure Valley Area

9 Counties (2001)

– Ada	–	312,337
– Boise	–	7,011
– Canyon	–	139,821
– Elmore	–	29,157
– Gem	–	15,482
– Owyhee	–	11,008
– Payette	–	20,868
– Washington	–	9,956
– Malheur County, Oregon	–	31,456
– Total	–	577,096



Courtesy Idaho Power Data

Study Area

- The study considers only feedstocks available within the 9 county area and markets within the 9 county area.
 - Feedstocks outside the area might be pre-empted by a biodiesel plant in that area.
 - Markets outside the study area would be competitive markets with other biodiesel producers

Study Area

- This area has and is experiencing rapid growth which should be considered when developing a business plan for a potential biodiesel plant
 - In the past 6 years, daily traffic volumes on I-84 linking Ada and Canyon counties increased nearly 50%
 - Recent population projections for Ada and Canyon counties indicate an increase of an additional 25% from 1998 to 2005.

Biodiesel Feedstocks



Biodiesel Feedstocks

- Virgin Oils
 - Rapeseed, canola, yellow mustard crops
 - Other specialty oil seed crops
 - safflower
 - sunflower
 - other
- Used Oil from restaurants and deli's
- Used Oil from processing plants
- Tallow

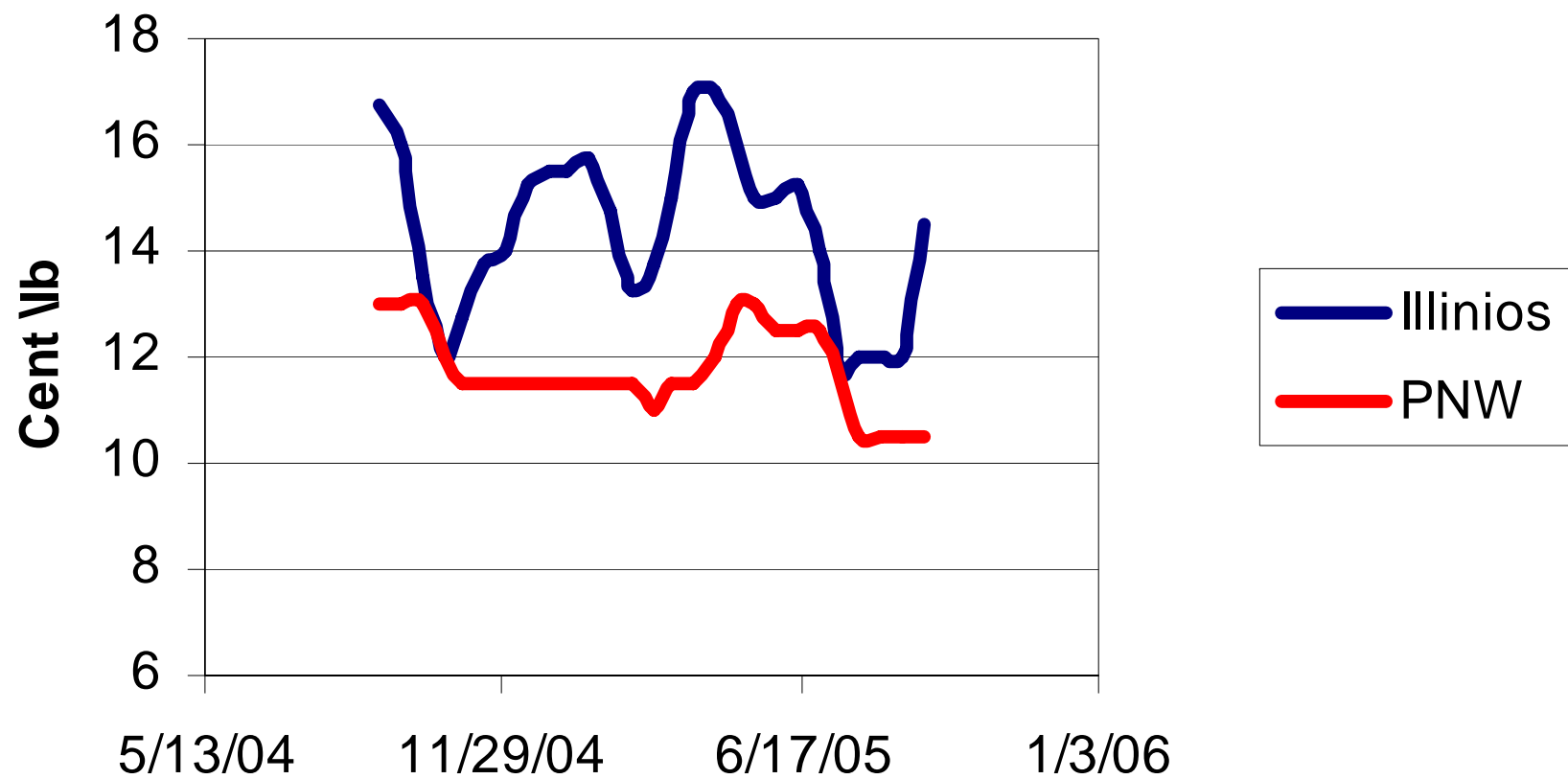
Biodiesel Feedstocks

- Used Oil from restaurants and deli's
 - Estimate 1.1 gallons per day per person (NREI)
 - 555,000 @ 1.1 gal/person/yr = 600,000 gal
 - Survey of current renders
 - = 1 million gal/yr - Collection area > TV
 - Challenge
 - estimate the percentage that can be obtained for biodiesel use
 - current renders are reluctant to give up current customers to supply a new, and uncertain market such as biodiesel -- cash talks
 - Setting up a system to collect these oils would be expensive and competitive

Biodiesel Feedstocks

- Used Oil from processing plants
 - information is proprietary
 - Biodiesel plant must negotiate individually
 - possibly 0-3 million pounds
 - supply not certain because of different products and re-use strategies
 - processing plant goal is to not have waste grease
 - High quality feedstock < 3% FFA

Yellow Grease Prices



Biodiesel Feedstocks

- Tallow
 - large supply
 - one meat processing plant recently closed
 - recent changes in livestock feed regulations prohibit this product from being used for feed
 - one of the most abundant sources of oil available in the Treasure Valley
 - Our estimate - 56 million pounds
 - current renders are reluctant to give up current customers to supply a new, and uncertain market such as biodiesel
 - may be negotiable

Biodiesel Feedstocks

- Current renders are reluctant to transfer oil from current customers to supply a new, and uncertain market such as biodiesel – everything is negotiable
- Starting a new oil recovery business
 - Duplicating current services
 - Define significant investment
 - Trucks
 - Tanks
 - Labor
 - Containment

Biodiesel Feedstock Virgin Oils

- Winter rapeseed
- Winter canola
- Mustard
- Alternative Oil Seed Crops
 - Sunflower
 - Safflower
 - Soybeans
- Other

Cropland Issues

- 8 or 12 year Crop Rotations
- Harvested acres -
800,000 harvested vs 1.1 million acres planted
- Yield estimate
 - 2200# seed/A (irrigated)
 - 40% oil content
- Oil yield: 105 gal/acre

Oil Seed Production

- Information is lacking on horticultural practices to optimize oil production in the Treasure Valley
- State average yield of canola is 1100 #/acre (54 gal/acre)
- Production under irrigation could be 2-2.5 times higher – 100-125 gallon/acre
- Winter rapeseed and winter canola are reportedly the highest oil yielding crops recommended for Idaho
- Safflower and sunflower are also potential oilseed crops that have been grown successfully in Idaho. Reported yields are 1200 #/acre on dryland to as much as 3000 #/acre under irrigation

Idaho Ag Ruling Pertaining to the Production of Brassica's

- To control diseases of the Brassica genus particularly blackleg
- to protect genetically developed varieties
- to protect the vegetable seed industry in southwest Idaho

Idaho Ag Ruling Pertaining to the Production of Brassica's

- Administrative districts within the study area
 - District IV - all land within the boundaries of Ada, Canyon, Gem, Owyhee (north of Murphy), and Payette
 - District V - All lands within the boundaries of Elmore, Owyhee (south of Murphy) and Washington

Idaho Ag Ruling Pertaining to the Production of Brassica's

- District IV - No rapeseed of either variety may be planted in District VI.
- District V - Only edible types of rapeseed may be planted, exceptions
 - Person planting industrial types can obtain written approval from all farmers bordering the fields to be planted
 - Must be at least one mile from a field planted to edible rapeseed

Oregon Ag Ruling Pertaining to the Production of Brassica's

- Oregon ag rule pertaining to production of Brassica is under revision. The revision is to address the concept of growing large areas for the production of oil for biodiesel.
- The proposed revisions protect the established seed producing areas which includes the Treasure Valley

Oregon Ag Ruling Pertaining to the Production of Brassica's

- Seed Producing Areas
 - Prohibits Brassica crops grown for oil production. Keeps the current 3-mile separation distance for canola/rape grown for seed.
 - Allows canola/rape if crop not allowed to flower.
- Non -seed areas:
 - Brassica crops grown for oil allowed
 - no separation between fields
 - no recording requirement
 - Same disease control measures are required

Oregon Ag Ruling Pertaining to the Production of Brassica's

- Seed Producing Areas : retains current disease control measures including:
 - use of certified seed and testing/treatment for blackleg
 - not be grown in the same field more than one year in four
 - location of canola fields be recorded at the appropriate OSU extension office.
 - Retain transportation security requirements, sealed containers

Oregon Ag Ruling Pertaining to the Production of Brassica's

- Non -seed areas:
 - Brassica crops grown for oil allowed
 - no separation between fields
 - no recording requirement
 - Same disease control measures are required

Alternative Oil Seed Crops

- Soybeans
 - Commercial varieties not adapted to cool night time temperatures & low humidity in Treasure Valley
 - OSU Malheur Experiment Station developing varieties adapted to the local climate
 - Some have yields -40-60 bu/A
 - Soybeans: oil content -17 to 19%

Alternative Oil Seed Crops

- Sunflower
 - Native North American plant
 - Food for North American Indians before colonization
 - Grown in Treasure Valley
 - Uses row crop equipment
 - Birds reduce yields
 - Heads are difficult to dry
 - Deep rooted plant

Alternative Oil Seed Crops

- Safflower
 - currently raised for birdseed at 12-14 and oil at 8-10 cents per pound, current production in southeastern Idaho 20,000 A, there are fields in Washington county.
 - Responds to hot dry conditions during flowering
 - Yield estimates- 2200 lb/A with 40% oil (Irrigated)
 - Dryland - 40 to 60% of irrigated
 - production 105 gallons per acre

Rotations Suggested for the Treasure Valley

Rotation	8 year	12 year
Crops*		
Grain	25	25
Alfalfa seed (3 yr)	15	15
Potatoes/sugarbeets	25	25
Corn	25	0
Dry beans/ onions	10	10
Mint (4yr)	0	25

* Data is % of crop land available

Greater Treasure Valley Agricultural Area

»	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	932,138	107,423
– Malheur County, Oregon	6,329,706	278,780
• Total	17,040,334	1,107,977

Biodiesel Feedstocks

Rapeseed and/or Canola

Pessimistic

Oilseeds Crop Acreage at 8% - 12 year Rotation

- Total Cropland,
Harvested acres 809,557
- Acres for oilseeds 64,765*
- Oil production based
105 gallons per acre 6.8 million gal
State Average yield 3.5 million gal

*Requires modification of ag order

Biodiesel Feedstocks

Rapeseed and/or Canola

Optimistic Oilseeds Crop Acreage at 15% - 8 year Rotation

- Cropland, acres 1,107,977
- Cropland available at 15%, acres 166,197*
- Oil production based
 - on 105 gallons per acre 17.5 million gal
 - State Average Yield 9.0 million gal

*Requires modification of ag order

Feedstock Production Summary

(Millions of Gallons)

Oil from Crops (25,000 to 166,000 acres at 54 to 105 gallons per acre)	1.35 to 17.4
Oil from Waste Grease (50% of current collection)	0.3 to 0.5
Oil from Processing Plants (50% of estimated 3 million pounds)	0.2
Oil from Tallow (50% of current 56 million pounds)	3.7
Total Estimated Supply	5.5 to 21.8

Biodiesel Market

- Potential customers
 - EPAC
 - State Fleets
 - DOT
 - National guard
 - Federal Fleets
 - Forest service
 - BLM
 - BREC
 - Utilities
 - Idaho Power
 - Intermountain Gas
 - Others
 - Public Transportation
 - Sanitation Companies
 - Boise City
 - Counties
 - School buses
 - Public

Diesel Consumption (gallons)

Data from Idaho Tax Commission

Idaho

246 million On-road

375 million Total

Diesel Consumption

- 38% of the Idaho motor vehicles in the study area
- 42% of the Idaho population in the study area

Based on the above, this study used 40% of the diesel consumption in Idaho in the Treasure Valley and added an equivalent amount per person for Malheur County

Biodiesel Market (millions of gallons)

	Treasure Valley	@20%*	@5%*
On-road Diesel	110	22	6
Total Diesel	166	33	8

*Blend ratio of biodiesel:diesel

Byproduct Utilization

Meal Market

Meal Uses:

Livestock feed

Boiler Fuel

Pesticide

Disposal problem

Byproduct Utilization

Meal

Safflower meal utilization

Biodiesel plant capacity (million gal)	Meal (ton)	Dairy cows required*
0.5	3,333	3,653
1	6,667	7,306
4	26,667	29,224
12	80,000	87,671
18	120,000	131,507

* assumes 5 lb. of meal included in ration

Byproduct Utilization

- Calves, Cattle, Cows in study area*

– 620,000	Southwest
– 215,000	Malheur County Oregon
<hr/>	
835,000	Total

*2004 Idaho Agricultural Statistics

CANADA: FEEDGRAIN USE*

<i>1999-2001 average</i>	Wheat	Barley	Corn	Oats	Other^v	Total Grains	Protein Meal^z	Total
.....thousand tonnes.....								
CANADA								
Beef Cattle	145	3,396	768	1,554	579	6,442	349	6,791
Dairy Cattle	116	952	1,824	60	344	3,295	471	3,765
Hogs	818	2,001	3,676	30	304	6,829	1,396	8,225
Chickens	402	179	836	0	40	1,456	391	1,847
Layers	274	0	250	0	43	566	133	699
Turkeys	100	0	131	0	11	243	81	324
Horses	0	71	22	178	13	285	27	312
Sheep/Lambs	<u>1</u>	<u>34</u>	<u>7</u>	<u>7</u>	<u>4</u>	<u>53</u>	<u>3</u>	<u>56</u>
Total	1,857	6,632	7,514	1,829	1,337	19,169	2,851	22,019

Byproduct Utilization

Meal Value

	Suitable for feed	Protein (%)	Value (\$/ton)#
Safflower	yes	25	\$120
Sunflower	yes	50	\$239
yellow mustard	*	-	
Canola	*	36	\$172
Rapeseed	*	36	\$172

*depends on glucosinolate content

#Current price of 47% protein soy meal is \$225 per ton

Byproduct Utilization

Glycerine Market

Glycerol Uses:

- Livestock feed

- Boiler Fuel

- Raw material for cosmetics, food, etc.

- Disposal problem

Glycerol Value:

- USP Grade - \$0.40 per pound

- Unpurified glycerol may be a disposal problem

Glycerol Production and Use

	<i>U. S.</i>	<i>Europe</i>	<i>Japan</i>	<i>Total</i>
<i>Annual capacity</i>	169	315	59	543
<i>Production</i>	159	247	53	459
<i>Consumption</i>				
<i>Personal/loral care products</i>	75	46	15.5	136.5
<i>Drugs/Pharmaceuticals</i>	14	24	23	61
<i>Foods/beverages</i>	42	27		69
<i>Polyether polyols</i>	17	33	6	56
<i>Tobacco</i>	22	15	5	42
<i>Alkyd resins</i>	6	17	7.5	30.5
<i>Other</i>	13	79	29	121

Table 5 – Production, Consumption, and Uses of Glycerol, 2001 (in thousands of tonnes;
source: Chemical Economics Handbook)

Byproduct Utilization

Glycerin

Glycerin as a ration component

Biodiesel plant capacity (million gal)	Glycerin (million lb)	Dairy cows required*
0.5	0.37	1,027
1	0.75	2,055
4	3	8,219
12	9	24,658
18	13.5	36,986

ssumes 1# per day

Traces of methanol not acceptable

Plant Size (Million Gallons Per Year) vs.
Processing Cost in Thousands of \$

	<u>Yellow Grease Only</u> 0.5	YG + Tallow 4	<u>64,765 Acres</u> @ 2200 #/acre 11	<u>157,500 Acres</u> @ 2200 #/acre 21
Feedstock	\$375	\$3,725	\$17,500	\$37,300
Methanol	\$56	\$450	\$1,236	\$2,360
Catalyst	\$36	\$292	\$802	\$1,530
FFA	\$50	\$400	\$400	\$400
Freight	\$25	\$200	\$550	\$1050
Crushing	---	---	\$1,425	\$3,465
Total Cost	\$693	\$6067	\$26,500	\$55,500
Cost - \$/gal	\$1.39	\$1.52	\$2.41	\$2.64

Plant Size (Million Gallons Per Year) vs. Income in Thousands of \$

	<u>Yellow Grease Only</u> 0.5	YG + Tallow 4	<u>64,765 Acres</u> @ 2200 #/acre 11	<u>157,500 Acres</u> @ 2200 #/acre 21
Biodiesel	\$1,100	\$8,800	\$24,180	\$46,200
Glycerol	\$28	\$220	\$604	\$1,155
Meal	0	0	\$5,628	\$13,700
Total	\$1127	\$9,020	\$30,400	\$61,045
Income, \$/gal	\$2.26	\$2.26	\$2.77	\$2.91
Profit, \$/gal**	\$0.87	\$0.74	\$0.35	\$0.26

** No program incentives considered and fob plant

Summary: Plant Size (Million Gallons Per Year) vs.
Cost, Income and Profit

	<u>Yellow Grease Only</u> 0.5	YG + Tallow 4	<u>YG + T + 64,765 Acres</u> @ 2200 #/acre 11	<u>YG + T + 157,500 Acres</u> @ 2200 #/acre 21
Income, \$/gal	\$2.26	\$2.26	\$2.77	\$2.91
Cost - \$/gal	\$1.39	\$1.52	\$2.41	\$2.64
Profit, \$/gal**	\$0.87	\$0.74	\$0.35	\$0.26

** No program incentives considered and fob plant

Plant Size Assumptions*

Oilseeds	\$0.097 cents/pound
Methanol	\$0.104 per gallon
Catalyst	\$0.073 per gallon
High FFA Processing	\$0.06 per gallon
Freight	\$0.05 per gallon
Crushing and Filtering	\$50.00 per ton
Cost of Plant Operation Heat Energy, electricity, labor, depreciation, maintenance, administration	\$0.20 per gallon up to \$0.30 per gallon for the smaller plant

*Reference: Building a Successful Biodiesel Business

Actual numbers for a particular plant may vary from data used.

Plant Size Assumptions* (cont'd)

Biodiesel Selling Price	\$2.20 per gallon
Glycerol value	\$0.05 per pound
Meal Value	\$125.00 per ton

*Reference: Building a Successful Biodiesel Business
Actual numbers for a particular plant may vary from
data used.

Plant Site Location

- Location will be size dependent
- Small plants will have more potential locations
- Large plants will be constrained by transportation vectors
- Large plants will need oil seed crushing capability(not in scope of study)

Processing Plant Requirements

Utilities

- Electricity
- Water
- Natural gas
- Waste water treatment
- Storm water run off

Processing Plant Capital Costs

Annual Production (Million Gal)	Capital Cost \$/gal
.5	2.00
1.0	2.00
5.0	1.25
10.0	1.00

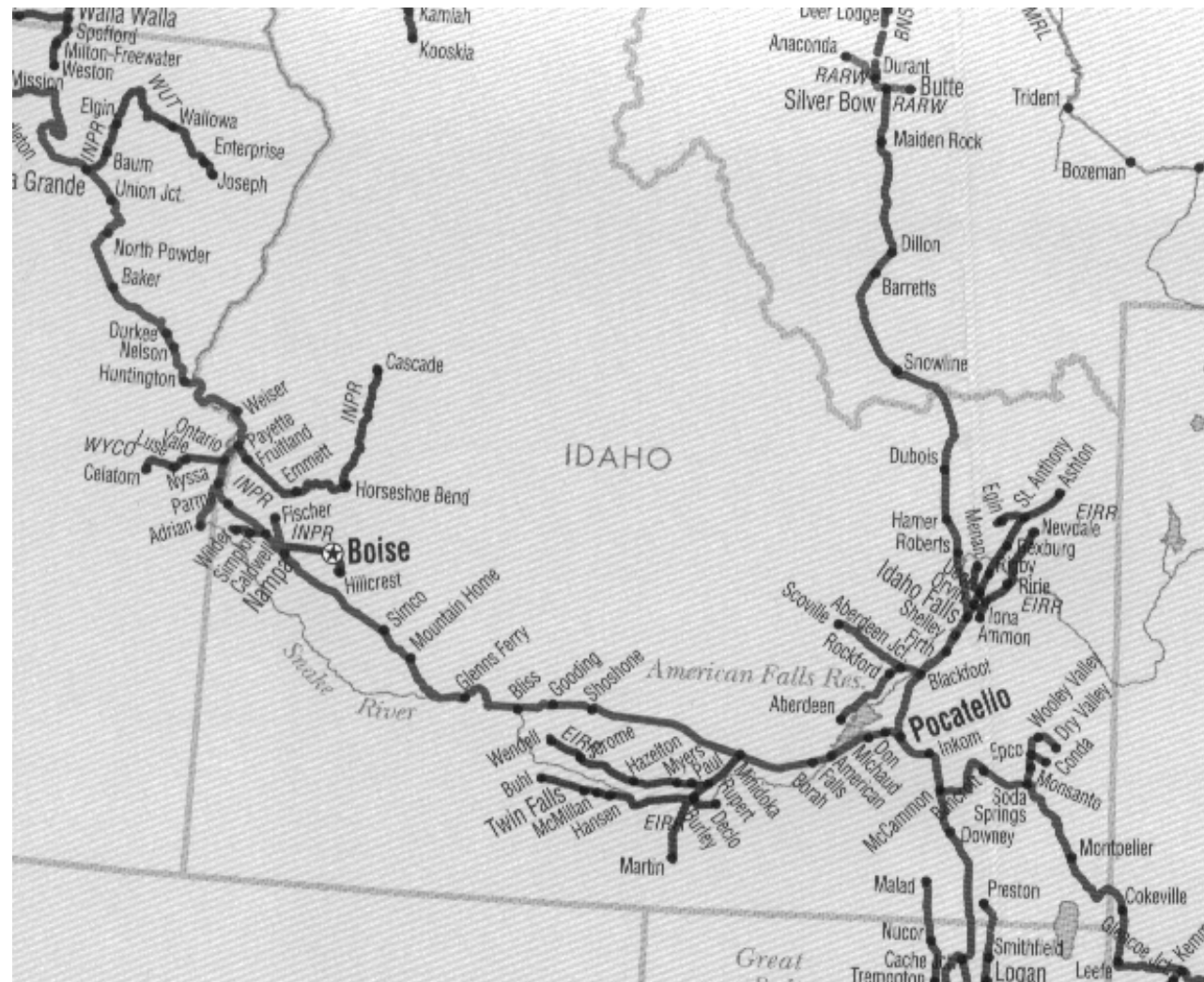
Plant Site Location

Idaho Northern &
Pacific Rail line



Plant Site Location

Union Pacific
Main rail line



Processing Plant Requirements

- Zoning requirements
 - Biorefinery (processing)-Industrial M1,M2
 - Individuals- Conditional use permit
- Counties
 - Limited industrial zones
 - Application for rezoning

Processing Plant Requirements

- Permits (Various permits depending on business size and location)*
 - Resource Conservation Recovery Act (RCRA)
 - Comprehensive Environmental Response Compensation and Liability Act (CERCA)
 - Emergency Planning and Community Right to Know Act (EPCRA)
 - Clean Water Act
 - Safe Drinking Water Act
 - Toxic Substances Control Act (TSCA)
 - Clean Air Act (CAA)
 - Oil Pollution Control Act

* Reference: Building a Successful Biodiesel Business, 2005

Project Summary

- Potential for a Biodiesel Plant in Treasure Valley
- Potential Biodiesel demand- 6 to 33 million gal
- Sufficient cattle for meal utilization
- Variety of feedstocks:
 - Used oil
 - Tallow
 - Oil seed crops

Potential Biodiesel production: 0.5 to 21 million gal

New market for oil seed crops in Treasure Valley

Project Summary: Constraints

- Ag order limits brassica production
- Previous history with used oil for Biodiesel
- Horticultural information for growing oil seed crops in study area
- No oil seed crush plant
- Limited uses for glycerol
- Market acceptance by major oil companies
- Permitting

Sponsors

- Idaho Department of Water Resources
Energy Division
- University of Idaho
 - College of Engineering
 - Department of Biological and Agricultural Engineering
 - NIATT

Questions

The End