

Opportunities and Barriers for Biodiesel Use in Washington State

Background

Biodiesel is a domestically produced, renewable motor fuel that can be made from vegetable oils or recycled restaurant greases. Biodiesel is non-toxic and biodegradable, and can be blended with petroleum diesel to reduce air pollutants such as particulate matter (PM), carbon monoxide (CO), hydrocarbons (HC) and air toxics. Biodiesel can be used in unmodified diesel engines at blending rates of 20% (B20). Higher blend rates or pure biodiesel (B100) may require certain engine modifications to avoid maintenance and performance problems associated with colder weather, or older engines.

Biodiesel has undergone extensive testing and use in both stationary and mobile applications and is registered as a fuel and a fuel additive with the US Environmental Protection Agency. Biodiesel has physical properties and characteristics that are similar to petroleum diesel and is defined by the American Society of Testing and Materials, Provisional Standard 121 (ASTM121).

Why use biodiesel?

Biodiesel fuel offers certain advantages over petroleum diesel. Primary among these is that biodiesel is a renewable, domestically produced fuel that can provide local economic benefits. According to an energy lifecycle study completed by the US Department of Energy, biodiesel yields 3.2 units of fuel energy for every unit of fossil fuel consumed. By comparison, petroleum diesel yields 0.83 units of fuel energy per unit of fossil energy consumed. Because biodiesel is derived from vegetable oils, carbon is also recycled. As a result, biodiesel can reduce CO₂ emissions by as much as 78% over petroleum diesel.

Biodiesel is also biodegradable, non-toxic, has a higher flash-point than diesel, offers good lubricity, and can provide emission reductions. The following table presents average biodiesel emissions compared to conventional diesel. This information is extracted from a table prepared by the National Biodiesel Board. Actual emissions will vary depending on vehicle age, load, use and maintenance.

Average Biodiesel Emissions Compared to Diesel

Emission Type	B100	B20
Total hydrocarbon	-68%	-14%
CO	-44%	-9%
Particulate matter	-40%	-8%
NOx	+6%	+1%
PAH	-80%	-13%
Sulfates	-100%	-20%

Action items: The Puget Sound Clean Air Agency (PSCAA) is currently interested in strategies that reduce particulates and air toxics. As a result, PSCAA is working to introduce ultralow sulfur diesel (ULSD) into the region. Biodiesel could work well with this program as it contains very low sulfur levels, offers measurable PM reductions and can aid in lubricity problems experienced by low sulfur diesel fuels. The PSCAA is aware of biodiesel and supports its use. Efforts should be made to work cooperatively with PSCAA to investigate where biodiesel would fit as part of their PM reduction programs.

Similarly, opportunities for biodiesel use may be available by promoting its greenhouse gas benefits. Currently local utility groups, most notably Seattle City Light, are exploring ways to reduce or offset greenhouse gas emissions from power generation. Biodiesel fits well with these activities and continued support for biodiesel should be encouraged in this arena. Finally, the Department of Ecology intends to review strategies for reducing diesel emissions over the next year or two. Biodiesel should be promoted as a potential strategy during this process.

Biodiesel Activities in Washington

Currently, there are no commercial biodiesel production plants in Washington. This could change soon, as various parties are looking into the possibility of building biodiesel facilities in the state. Production projects have been mentioned in Whatcom, King, Spokane and Benton counties, and vary in size from 1 to 3 million gallon per year (MGY) in Spokane, to as large as 17 MGY in Richland. It is too early to say which, if any, of these facilities will be built. Much will depend on the availability of financing and on the ability of the developers to correctly gauge and develop market demand for biodiesel.

While production is non-existent, consumer interest in biodiesel is growing. The City of Seattle is just completing a year long, 20 vehicle demonstration project evaluating the feasibility of using biodiesel in various fleet applications. In November, 2001, the City of Tacoma awarded a 3 year contract to a local card-lock fuel supplier (PetroCard) to provide up to 200,000 gallons of B-20 annually for mobile fuelling of 85 city refuse trucks. Tacoma Power signed a similar agreement for up to 45,000 gallons of B-20 to fuel Tacoma Power line trucks. Earlier this fall, the University of Washington issued a bid request for 37,000 gallons of biodiesel, while both the Navy and Mount Rainier National Park have recently begun purchasing biodiesel for on-site operations.

Others including school districts, transit companies, local governments, private fleets and individual motorists have expressed interest in biodiesel, or have tried it on a limited basis. One of the largest fuel consumers in state government, Washington State Ferries (WSF), is an example of how a large fleet could effect biodiesel markets in Washington. WSF consumes up to 20 million gallons of diesel fuel per year and has shown an interest in biodiesel. Even at a modest 5 percent offset, WSF would consume up to 1 million gallons of biodiesel per year. This is a significant amount of fuel and could provide a solid market base for a local biodiesel production plant.

Biodiesel's market potential has also captured the interest of fuel distributors as well. Probably the most active biodiesel distributor to date is Lilyblad Petroleum of Tacoma. Lilyblad is committed to developing a biodiesel market and is currently the major distributor of biodiesel fuel in western Washington, with World Energy of Chelsea, Massachusetts, its primary supplier. Large cardlock fuel companies such as PetroCard and CFN are also looking at biodiesel market opportunities. Similarly, smaller retailers have begun to show interest in biodiesel sales as evidenced by the recent opening of a small biodiesel retail outlet in Seattle operated by Dr. Dan's Alternative Fuel Werks.

Action items: A market survey of potential private and public fleet operators should be conducted to determine interest in biodiesel and identify market barriers that are currently in place. This would allow policy makers to better understand the potential market for biodiesel, as well as identify barriers and opportunities that could form the basis for related policy actions. The survey should also extend to potential producers of biodiesel.

Biodiesel Supply and Feedstocks

Biodiesel is made from virgin seed oils such as soybean, canola or rapeseed; or from recycled cooking oils, often referred to as yellow grease. While there are no biodiesel production plants in Washington at this time, nationally there are at least 13 major suppliers and a current dedicated production capacity of about 80 million gallons per year. In addition to dedicated production capacity, there is available production capacity within the oleochemical industry. Currently, excess capacity exists in this industry, with some estimates of up to 200 million gallons of production capacity available for long-term production agreements.

Waste cooking oils

Waste cooking oils and related waste oil products offer the lowest cost mode for producing biodiesel at this time. This is because the price of waste cooking oil is lower than seed oil. Also, waste oils are generated locally, thereby minimizing transportation costs, provided the biodiesel is also produced and consumed locally.

The principal use for yellow grease is as a supplement to animal feed. According to the National Renewable Energy Labs (NREL), yellow grease has an average market price of around 9 cents per lb. It is expected that yellow grease prices in Washington are similar, however, prices will vary regionally. For instance, a recent study completed in California saw prices as low as 6 cents per pound. These low prices represented a change from several years ago, where yellow grease commanded as much as 18 cents per pound. At that time, restaurants were actually paid from 1 to 2 cents per pound for their used cooking oil.

The drop in California's yellow grease price was due primarily to a reduction in demand by the animal feed industry. The California study explained this drop as a result of industry concern over the possible presence of bovine spongiform encephalitis (Mad Cow

Disease) in the grease. Also, the market for yellow grease softened with the collapse of many Asian economies, a major market for animal feeds. As a result, restaurants went from getting paid for used oil, to having it picked up for free, to even being charged a "tipping" fee for disposal. According to the California study, most rendering companies expect that the greatest drop in yellow grease prices has already occurred and that the market will see prices continue to rise. In general these prices track about 6 to 10 cents per pound lower than virgin soy oil.

Nationally, NREL estimates about 456 million gallons of yellow grease and inedible tallows are generated per year. Brown grease, (degraded yellow grease and trap grease) has an estimated annual volume of 518 million gallons. Together, these waste oils amount to about 974 million gallons of potential feedstock per year.

The amount of waste cooking oil generated in Washington is unknown; however, it is possible to estimate supply. A recent study by NREL estimates that an average of three gallons of waste oil is generated per person, per year. Given a population base of approximately 5.89 million people, Washington State generates about 17.67 million gallons of waste cooking oil per year, an amount equivalent to about 17.6 million gallons of biodiesel. By comparison, on-highway diesel use in Washington exceeded 560 million gallons in 2000.

Action items: This estimate of yellow grease supplies is probably conservative given the large presence of vegetable processing companies operating in Washington State. These plants generate a large amount of used cooking oil and would be a primary target of supply for an emergent biodiesel industry. A survey of yellow grease supply as well as other waste oils generated in Washington State would help define this resource. This study should determine the amount, type and location of waste cooking oils generated in Washington State, competing markets, prices, and existing collection methods.

Oil seeds

Much of the vegetable oil sold into US markets is produced from soybeans. Similarly, most of the biodiesel produced from virgin seed oils is derived from soybeans. While commodity prices fluctuate widely, on average, soybean oil trades for around 18 to 20 cents per pound.

Soybeans are grown primarily in the midwest and their cultivation does not appear to interest Northwest growers. Oilseed crops that may be of interest are canola, rapeseed, and mustard seed. All three of these seeds are grown in the Northwest, although not in significant quantities, and can be used in rotation with wheat, a major Northwest agricultural product. There is also some interest in sunflowers, with at least a couple of hundred acres currently under cultivation in southwest Washington.

Between 1992 and 1999, the average commodity price for canola seed ranged from a low of 7.8 cents per pound in 1999 to as much as 12.9 cents per pound in 1996. Rapeseed

went from a high of 13.3 cents per pound in 1996 to a low of 8.7 cents in 1999, while mustard seed ranged from 16.9 cents per pound in 1996 to 11.4 cents per pound in 1999. A crop enterprise budget study prepared by WSU in 1991 indicated that farm costs for oil seeds ranged from 11 to 15 cents per pound. At these costs, oilseeds represent a fairly marginal crop for growers. An updated study of farm costs should be completed to determine current breakeven prices for growing oil seeds in Washington State. Whitman County has started this process. Their efforts should be supported and if necessary, expanded upon.

The University of Idaho reports that an acre of rapeseed grown as a winter crop in northern Idaho would yield about 2000 pounds of seed or approximately 100 gallons of vegetable oil, and 1200 pounds of meal. Higher yields may be possible for other oil seeds, or for other geographic locations, but this value will serve as a placeholder for estimating potential supplies. Dennis Roe, a WSU agricultural agent, estimates the maximum potential for oilseed acreage in Washington State is about 1 million acres. Assuming a conservative yield of 100 gallons of vegetable oil per acre, Washington State growers could produce as much as 100 million gallons of seed oil annually if all available acreage was planted.

Even if seed oil crops were to be grown in Washington, a question remains whether the seed oil would find its way into the biodiesel market. The primary market for seed oil is the food and oleochemical industry, which manufactures a variety of consumer goods. This is a higher value market, with the biodiesel industry representing a secondary market for lower grade oils and or surplus sales.

Markets can be distorted, however, as evidenced by a current USDA subsidy. The USDA Commercial Commodity Credit program currently buys down the cost of virgin vegetable oils that are used as feedstock for biofuels production. The 2 year program, which may or may not end this year, was intended to provide a 40 percent price discount in order to build industry capacity. Apparently the program may have been even more attractive than this, as some suggest that soybean oil became virtually "free" to some biodiesel production facilities. As a result, most of the biodiesel produced over the last year was derived from virgin vegetable oils. This "free" oil is also responsible for a reduction in biodiesel prices, which at times approached diesel prices.

Legislation, such as the renewable fuels standard currently being proposed by Congress, could also effect the market for seed oils. The legislation calls for 2.3 billion gallons/yr of renewable fuels to be used in 2004, increasing to 5 billion gallons/yr by 2012. Even if this legislation passes, biodiesel markets still need to offer competitive pricing for seed oils. If not, the oil will be sold into other markets or, more likely, farmers will not commit to expanding oil seed production beyond current market demand. In identifying opportunities for oilseeds, researchers are looking hard at co-products, and how they might help improve seed-oil economics.

One crop that may be of potential interest is mustard. Mustard seed-oil is not considered a quality food oil, thereby reducing its food market value. However, mustard seed rotates

well with wheat, has low water and fertilizer requirements, and offers good oil yields. Most importantly, mustard seed meal appears to be an excellent organic pesticide. In this market, the value of the meal is estimated at 15 cents per pound or higher. NREL and the University of Idaho are very excited about this market. They see this as an opportunity to reduce seed-oil costs, which they estimate at 10 cents/lb or less for mustard oil if a market for the meal can be established.

Work still needs to be done, however, to optimize a mustard hybrid that has good yields and a high concentration of glucosinolates, an organic pesticide. But progress is being made, and NREL estimates a 3 to 5 year time horizon before it is ready for commercial introduction. Commercial acceptance of the meal as a pesticide will take even longer, with NREL hoping to penetrate 10 percent of the pesticide market by 2030.

Action items: While oilseeds grown in Washington could represent a large, potential feedstock for biodiesel, there are a number of issues that need to be better understood, including:

- ◆ What is the on-farm cost of growing oilseeds in Washington?
- ◆ How do oilseeds fit into current agricultural practices and what needs to be done to support this industry?
- ◆ What is a realistic estimate of oilseed crop potential and how vulnerable are these crops to outside competition? In other words, if a seed oil industry is established in Washington, can other states, or countries such as Canada or Mexico undercut Washington growers.
- ◆ What crops offer the most value both in direct and co-product sales?
- ◆ What situation needs to occur to ensure that seed-oil finds its way into the biodiesel market?
- ◆ Are there different organizational schemes, such as "New Generation Farmer Coops", that would allow growers to better leverage their activities?
- ◆ How do/will federal (and state) agricultural, environmental and energy policies effect the development of an oil seed industry in the Northwest?

These questions and others need to be addressed to better understand the potential of a seed-oil industry in Washington and its ability to support biodiesel production.

Biodiesel Plant Economics and Pricing

Biodiesel production benefits from economies of scale. NREL estimates about a \$0.50 per gallon increase in production costs between a 3 million gallon per year (MGY) plant and a 10 MGY biodiesel plant. Biodiesel production costs are also sensitive to feedstock price. At a feedstock price of \$0.10 per/pound, a production cost of about \$1 per gallon is projected for a 10 MGY facility, rising to a \$1.50 per gallon for a 3 MGY plant. If the price of feedstock increases to \$0.20 per pound, plant production costs increase to \$2 per gallon for a 10 MGY plant and about \$2.50 per pound for a 3 MGY plant. Biodiesel producers also benefit from the sale of glycerin, a byproduct of the production process. Glycerin is a commodity that is used in a variety of manufactured products. Smaller,

isolated production plants may be at a disadvantage in selling glycerin, which would affect their bottom line.

While production costs favor a larger plant, smaller facilities may still be competitive depending on the situation. The benefits of a smaller, modular plant is that it can be installed locally, use locally collected recycled oil, and sell to locally operated fleets. For example, Biodiesel Industries Inc (BII) of Marathon, Florida operates a 1 MGY, modular biodiesel plant in Las Vegas, Nevada. BII is able to collect yellow grease directly from local restaurants at no cost, transport the collected oil to their plant for minimal hauling charges and sell directly to customers in the immediate Las Vegas area. Using this model, BII is able to *sell* biodiesel at about \$1.25 per gallon (ex-tax). Whether this project is unique in its ability to keep prices low, or represents a possible model for other businesses, should be evaluated.

Transportation costs will also impact the sale price for biodiesel. Currently biodiesel sold into Washington markets is shipped from the mid-west or east coast. A local biodiesel distributor estimated that transportation or freight charges added about \$0.20 per gallon to the price of biodiesel sold in Washington. Most of this price would be avoided if biodiesel was produced locally.

Biodiesel prices in Washington are currently running around \$1.45 per gallon FOB. This is an ex-tax price and will vary somewhat with the volume purchased and whether it is delivered or picked up. If the cross-country freight charge of about \$0.20 per gallon was eliminated, then the price would drop to about \$1.25 per gallon. At a 20 percent blend rate, B-20 should have a sale price, including state fuel tax, of around \$1.15 per gallon. This assumes no delivery or additional handling or sales charge, \$1.45 per gallon B-100, and \$0.95 per gallon diesel.

At this point in time, biodiesel prices are lower than they have ever been. Whether prices will continue to drop is uncertain. Some of this recent price drop may be explained by increased production, and perhaps, a drop in yellow grease prices. However, the availability of the federal USDA credit is a more likely reason for this price decrease. Biodiesel producers have been getting their feedstock at dramatically reduced costs, and in turn, have passed at least some of these savings on to the consumer. If this subsidy disappears, prices should increase and biodiesel's growing market share may suffer.

Even at these historically low prices, consumers are paying more for biodiesel than they would for petroleum diesel. Many who would like to use biodiesel, can't or won't, because of this higher cost. Most of the consumers that are using biodiesel are doing so to comply with federal alternative fuel mandates, or are trying to get a head start on future EPA diesel emission requirements. Unless a change in public policy or a breakthrough in production costs occurs, any significant penetration of the distillate fuel market by biodiesel is unlikely.

Action items: Incentives encouraging both biodiesel production and use should be examined. Look to other states to see what has worked. For example:

- ◆ Hawaii, Montana, North Dakota and Texas have reduced or eliminated the state fuel tax levied on biodiesel.
- ◆ Iowa and Missouri established a "Biodiesel Revolving Fund" which pays the incremental cost of biodiesel used by state agencies. The Iowa fund is paid for through the sale of EPA Act credits.
- ◆ Kansas and Minnesota have both attempted to pass legislation mandating a 2% biodiesel content for diesel sold in the state. Kansas has since put in practice this requirement for all state owned diesel powered vehicles. Minnesota is expected to reintroduce legislation mandating a 2% minimum content law during the 2002 legislative session.

What Washington State Can Do- An Action Plan

Biodiesel is an attractive fuel and can offer a number of benefits to the citizens of Washington. These benefits include reduced emissions, greater fuel independence and possibly, economic development opportunities stemming from in-state production of both seed oils and biodiesel. A number of questions remain to be answered; however, before a clearer understanding of biodiesel's potential can be made. The following list includes a series of actions that would help define this resource and its market potential.

- ◆ Support a study examining the barriers and opportunities for growing seed oil crops in Washington State. Study should concentrate on value-added crops such as mustard seed. Focus of study should be from a growers perspective- ie cost of production versus value of end products.
- ◆ Prepare an economic development analysis looking at the in-state benefits resulting from increased production and use of biodiesel.
- ◆ Support NREL and University of Idaho's commercialization of mustard meal as an organic pesticide. Participate in pilot crop and pesticide demonstration projects.
- ◆ Complete a waste oil (yellow grease) feedstock availability study. Determine sources; types of waste oil and quantities produced; prices paid; cost of collection; competing markets.
- ◆ Assess State of Washington diesel use. Work with state fuel procurement agent to identify large state agency diesel consumers. Determine location of use and survey for biodiesel interest.
- ◆ Conduct market survey of potential private and public sector end-users of biodiesel.
- ◆ Support placing biofuels on state fuel contract. Examine possible leveraging of use through compliance with federal Energy Policy Act requirements for state fleets.
- ◆ Examine the cost and benefits of biofuels incentives, including production tax credits and the adoption of a minimum content requirement similar to that being proposed for the state of Minnesota. Support exempting biofuels from proposed near-term motor fuels tax increase.

- ◆ Work with the Department of Ecology as it completes a diesel emissions inventory and proposes mitigation strategies for diesel emissions. Advocate for biofuels where appropriate.
- ◆ Support Puget Sound Clean Air Agency's efforts to reduce diesel emissions and advocate for biodiesel as part of this campaign. A study examining the costs and benefits of burning ultralow sulfur diesel, biodiesel and both fuels in combination should be completed to help develop a least cost emissions reduction path.
- ◆ Participate in Seattle City Light 's and Oregon's Climate Trust Greenhouse Gas Reduction program and represent the interests of biofuels as potential GHG strategies.
- ◆ Support local advocacy groups (eg. Puget Sound Clean Cities Coalition, Spokane Conservation District) efforts to develop biofuels market.
- ◆ Support current state alternative fuels legislation-SB 6285 and HB 2566.
- ◆ Support federal legislation calling for Renewable Fuels Standard.
- ◆ Work with Washington State Weights and Measures Department to determine any state standards required for the sale and dispensing of biofuels.