07 - 0486

TECHNICAL AND ECONOMIC ANALYSIS: BENEFITS OF USING BIODIESEL AS HEATING OIL

FINAL REPORT

FEBRUARY 2007

Ken Wolf
Reliability Administrator
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101-2147

Environmental Consulting and Training Services, Inc.
1100 Marion Street, Suite 301
Knoxville, TN 37921
(865) 521-9898 Office
(865) 521-9990 Fax

"A Qualified Woman-Owned, HUBZone Small Business"

Table of Contents

1.0 INTRODUCTION

The purpose of this document is to report the findings of the technical and economic analysis of the benefits of using biodiesel blends (also known as *BioHeat*®[1]) as heating oil in Minnesota. An analytical approach was utilized to develop estimates of impact to various measures of the Minnesota economy that would be expected to occur as the result of using biodiesel as heating fuel.

Fuel-oil usage in Minnesota has declined significantly in the past four decades as natural gas has increased in availability statewide. Usage of fuel oil is much more predominant in the Northeast portion of the United States, where substantial research has been conducted using biodiesel blends. Fuel oil suppliers in Massachusetts, Pennsylvania, New York, and Maine are marketing biodiesel blended with low-sulfur No. 2 fuel oil under the brand name *BioHeat*®. As a result, much of the information on the benefits and limitations of using biodiesel blends for heating oil comes from studies conducted in the Northeastern United States.

The capability of using various levels of biodiesel fuels as replacements for 100% petrodiesel heating fuels has been demonstrated in numerous studies. In general, the benefits include reduced emissions of air pollutants, a reduction in replacement costs for equipment, and a reduction in health problems in the general public. Historically, however, biodiesel fuel has been more expensive than petrodiesel fuel. With the increase in costs of petroleum distillate fuels over the past few years, this disadvantage has been lessened.

The analytical approach utilized in this study involved the development of estimates of impact to various measures of the Minnesota economy that would occur as the result of using biodiesel as heating fuel. The impacts were developed based on the capture of various percentages of the Minnesota heating oil market. For instance, the study examined the impacts on the Minnesota soybean farming industry if biodiesel fuel use captured 5%, 10%, and 20% of the heating fuel market. Impacts that were examined include the percentage of soybean production utilized for heating fuel production, and an estimate of the impact on the biodiesel production capacity of Minnesota.

Other variables studied included the purity of biodiesel that could be utilized as heating fuel. Biodiesel is available at 100% levels, but is generally used as 20% (B20) and 5% (B5) blends with petroleum distillate diesel. It is also frequently utilized as an additive at 2% biodiesel.

This study also examined the impacts to a typical heating installation in terms of equipment changes that may be necessary to utilize biodiesel at varying levels of purity.

[1] For the purpose of this study, the term *bioheat* is used to generally describe biodiesel that is used as a home heating fuel and *B20 bioheat* is used to describe a blend of 20% biodiesel and 80% No. 2 home heating fuel oil. *BioHeat*® is a new industry-accepted, branded term for any blend of pure biodiesel with conventional high- or low-sulfur petroleum home heating oil. To qualify as *BioHeat*®, the petroleum portion of the biodiesel blend must meet the specifications of ASTM D396, and the biodiesel portion must meet the specifications of ASTM D6751, prior to blending.

2.0 AVAILABILITY OF BIODIESEL IN MINNESOTA

2.1 Availability of Biodiesel Blends as Home Heating Oil in Minnesota

As a first step in this analysis, various fuel oil distributors across the state of Minnesota were contacted and interviewed regarding the availability of biodiesel blended fuel oil. At the time of this study, none of the fuel oil distributors contacted offered biodiesel blended fuel oil. When questioned as to why biodiesel blended fuel oil was not available, the majority of distributors stated that the use of biodiesel blended fuel oil was not mandated by the state of Minnesota; the consensus was that there were issues with cold weather blending and distribution.

2.2 Distribution and Delivery of Biodiesel Blended Heating Oil to Home Heating Oil Tanks

A distribution and delivery network for biodiesel blended heating oil is not currently established in Minnesota. Common concerns among distributors are the cold weather properties of biodiesel and potential blending issues. Minnesota mandated a blend of B2 biodiesel for all diesel fuel in 2005. Various studies have been conducted since that time to identify cold weather blending issues. Lessons learned as a result of the B2 mandate should be beneficial for future biodiesel product implementation, such as biodiesel heating oil.

2.3 Expected Impact on Fuel Oil Furnace Burners, Piping, and Tanks, and Upgrades or Changes That May be Necessary to Reasonably Use Biodiesel as a Fuel Oil

All known oil tanks and systems are compatible with *Bioheat*® fuel at blends of 20% or less[2]. All known gaskets, seals, hoses, and O-rings are compatible with blends of 20% or less biodiesel. Therefore, no cost of conversion is expected to enable the utilization of B20 biodiesel blends.

For higher biodiesel blends, up to and including 100% biodiesel, compatibility will depend on the materials (metals, plastics, and rubber parts) in tanks, pumps, and fuel lines. Use of tanks or lines made of brass, bronze, and copper, or lead, tin, and zinc (i.e., galvanized) may cause high sediment formation and filter clogging and are not recommended.

It should be noted that Underwriters Laboratories (UL) currently requires that residential oil burners and all related components be approved to burn No. 2 fuel oil that adheres to ASTM specification D396. While biodiesel meets a separate ASTM specification (ASTM D6751), it is unlikely that heating equipment manufacturers will fully embrace bioheat until UL approval for biodiesel products is obtained. At the same time, equipment manufacturers recognize that bioheat represents a growing market and business opportunity. As a result, many are eager to see an ASTM specification for a bioheat blend and UL approval of the use of bioheat or the *BioHeat*® trademark.

[2] http://www.biodiesel.org/news/taxincentive/Biodiesel%20Notice%202005-62.pdf

3.0 ECONOMIC ANALYSIS OF BIODIESEL IMPACTS

3.1 Price Differences per Gallon of Biodiesel When Compared to Conventional Fuel Oil

As a result of federal tax incentives for biodiesel producers, the price structure of biodiesel blended products is very competitive with that of petroleum diesel. A $1.00 per gallon tax credit (or cash) is provided to biodiesel producers for each gallon of B99.9 produced[3]. Given the current price of petroleum fuel oil, coupled with the $1.00 per gallon incentive provided for biodiesel producers, a significant price difference between biodiesel heating oil and petroleum heating oil is not anticipated.

3.2 Necessary Increases in Production of Biodiesel in Minnesota

The Energy Information Administration puts Minnesota total heating oil consumption in 2005 (the latest year for total use statistics) at 80,365,000 gallons for both residential and commercial heating oil use[4]. Current biodiesel production capacity from soybean oil in Minnesota is reported to be 60,000,000 gallons[5] annually.

As shown in Table 1, if biodiesel heating oil were to capture 20% of the heating oil market, a total of 16,073,000 gallons of blended biodiesel would be required. If the 20% market share were sold totally as B5, 803,650 gallons of B100 would be required; if the market share were sold totally as B20, 3,214,600 gallons of B100 would be required.

The production of an additional 3,214,600 gallons of B100 would represent an increase of approximately 5.4% over current levels. Current B100 production varies on a seasonal basis; in fact, the months of November through March are slower months for the biodiesel producers because of lower demand for biodiesel products during the cold months of the year. Use of biodiesel blended heating oil would benefit biodiesel producers by providing a more stable market. Table 1 lists the quantities of B100 biodiesel required to meet other market shares...

Table 1 Total Gallons B5 and B20 Blends

Total Gallons of Biodiesel Heating Oil Blend Required for Various Market Share Levels	5% Market Share 4,018,250	10% Market Share 8,036,500	20% Market Share 16,073,000
Gallons of B100 Required for B5 Blend	200,913	401,825	803,650
Gallons of B100 Required for B20 Blend	803,650	1,607,300	3,214,600

[3] Vermont Biodiesel Project, Laboratory and Field Testing of Biodiesel as Residential Space Heating Equipment

[4] http://tonto.eia.doe.gov/FTPROOT/petroleum/053505.pdf

[5] http://www.biodiesel.org/buyingbiodiesel/producers_marketers/ProducersMap-Existing.pdf

3.3 Necessary Increases in Soybean Production in Minnesota

Total soybean production in Minnesota for reporting year 2004 (the last year of complete statistics) was 236,175,000 bushels[6].

For the purpose of this analysis, hypothetical market shares of 5%, 10%, and 20% biodiesel heating oil were examined. Table 2 lists the increased soybean production that would be required to meet these different blends and their corresponding market shares.

As shown, the largest increase in required production would occur in the event that 20% market share were captured by a B20 blend. Even this level of demand would result in only a 1% increase in demand for soybeans.

Table 2 Probable Required Increases in Soybean Production Needed (Bushels)

Heating Oil Market Share	5%	10%	20%
B5 Blend: Needed Increase in Soybean Production	133,942	267,833	535,766
B20 Blend: Needed Increase in Soybean Production	535,766	1,071,533	2,430,666
Beneficial Impact to Farmers @ $6.70 per Bushel	$897,411 (B5) $3,589,632 (B20)	$1,794,481 (B5) $7,179,271 (B20)	$3,589,632 (B5) $16,285,462 (B20)

3.4 Projected Economic Impact to Refineries, Distributors, Farmers, and End Users

Increased use of biodiesel, specifically for heating oil applications, would potentially increase revenue for producers of biodiesel, as well as for soybean crop farmers. Currently, there are federal tax incentives for biodiesel blenders, which are eventually passed on to the end users. This tax incentive brings biodiesel-blended products to similar pricing as that for non-blended products At current market prices for soybeans (assuming a price average of $6.70 per bushel), total revenue to the farm economy would vary from approximately $900,000 to $16,285,000, depending on the market share of biodiesel for heating oil and the purity of product (B5 or B20). End users of biofuel heating oil would also benefit from a cleaner burning fuel.

[6] http://www.nass.usda.gov/mn/agstat05/agstat05.htm#Crops