Section 5.2: Biodiesel[1]

Topic/Issue Description

Biodiesel is produced using oils extracted from crops, animal fat, or waste vegetable oil. using a chemical process called transesterification. In this process, glycerin is separated from the fat or vegetable oil, generating two products—methyl esters (the chemical name for biodiesel) and glycerin (which can be used in soaps and other products).

Most U.S. biodiesel is produced from soybean oil, although other vegetable oils such as canola, corn, cottonseed, flax seed, sunflower, or peanut oil can be used, but their use will be largely dictated by price. Soybean oil is generally less expensive than other vegetable oils, is readily available in most parts of the country, and, unlike animal fat or waste oil, has a homogeneous and predictable composition.[2] Soybeans are processed into soybean oil through solvent or mechanical extraction. In solvent extraction, which is the predominant method, the soybean oil is extracted by exposing the cleaned and shelled soybeans to the solvent hexane. Mechanical extraction involves heating and grinding the soybeans to produce soybean oil and protein meal. Solvent extraction removes significantly more of the available oil than mechanical extraction, but mechanical extraction is more economically feasible for small processing operations.[3]

As of December 2007, Kansas has two small biodiesel refineries with capacities of 1 million gallons per year (MGY) or less.[4] One 72-MGY biodiesel plant is under construction in Emporia by Renewable Energy Group.

With the growth in the biodiesel industry, demand for soybeans has increased. In August 2007 the feedstock cost from soybeans was approximately $3 per gallon of biodiesel.[5] In order to expand production, biodiesel refiners are looking beyond soybeans towards other, less expensive feedstocks.

Environmental Impacts—Biodiesel production uses roughly three gallons of water per gallon, about a gallon of which is consumptive use.[6] Wastewater from biodiesel plants, which may

[1] For charts and graphs related to biomass and biofuels, please refer to the *Kansas Energy Chart Book*, Chapter 5 (http://kec.kansas.gov/chart_book/).
[2] Robert L. Stroup, 2004, Feedstock Considerations for Future U.S. Producers, Biodiesel Magazine (Jan./Feb. 2007): http://biodieselmagazine.com/article.jsp?article_id=649&q=&page=1 (accessed October 2007).
[3] Schumacher, Joel, 2007, Overview of Oil Crushing and Processing Technologies, *2007*, Montana State University, Dept. of Economics and Agricultural Economics: http://www.deq.state.mt.us/Energy/bioenergy/Biodiesel_Production_Educ_Presentations/Extraction_Tech_J_Schumacher_Polson_Oct2007.pdf (accessed December 2007).
[4] National Biodiesel Board, 2007, Commercial Biodiesel Production Plants (September 2007): http://www.biodiesel.org/buyingbiodiesel/producers_marketers/ProducersMap-Existing.pdf (accessed October 2007).
[5] Western Farm Press, 2007, High Soybean Prices Take a Bite out of Biodiesel, Aug. 21, 2007: http://westernfarmpress.com/news/082107-soybean-prices/ (accessed October 2007).
[6] This use is expected to decrease as recycling technologies are introduced and perfected.

contain high amounts of oxygen, grease, and oils, is regulated by the Kansas Department of Health and Environment (KDHE).[7]

Compared to standard diesel's life-cycle emissions, biodiesel emits 78% less carbon[8] and 75–83% fewer particulates. However, NO_x emissions for biodiesel are slightly higher based on standard laboratory (i.e., test stand dynamometer) testing procedures.[9] Under more "real-world" conditions, recent research found that NO_x emissions from biodiesel were not significantly higher than those of standard diesel fuels.[10]

Distribution and Blending Issues—Unlike ethanol, biodiesel is non-corrosive and may be transported in the existing pipelines if they are heated and insulated to prevent gelling. Magellan Midstream Partners, a pipeline corporation with mileage in Kansas, has plans to test pipeline shipping of B5 from Houston to Dallas and anticipates shipping B10 in the future.[11]

To ensure blend homogeneity, biodiesel uses a technique called ratio blending. Ratio blending injects biodiesel and petrodiesel into a tank at proportionate rates, creating a suspended mixture, as opposed to the splash blending technique used for ethanol, which creates a stratified mixture. (However, splash blending, with adequate after-mixing in the transport truck, has been shown to work well and may be the only method available in some localities.) Ratio blending equipment is expensive, and the process requires that biodiesel and petrodiesel be brought to the same site prior to blending. Currently, the McPherson terminal is the only Kansas fuel distribution terminal to provide blended biodiesel.

Due to biodiesel's potential to gel in cold weather, marketers may need to provide heated storage and purchasers may need to use biodiesel blends that will not congeal in prevailing weather conditions. Although biodiesel requires no engine or fuel system modifications to run in diesel engines, engine manufacturers have expressed concerns over problems (e.g., clogged fuel filters and sticking piston rings) associated with earlier use of high biodiesel blends. Currently, most major manufacturers support using blends up to B20 in their engines

[7] Donald Carlson, Kansas Dept. of Health &Environment, Bureau of Water, personal correspondence, December 2007.
[8] John Sheehan and others, 1998, Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus, Final Report Prepared for U.S. Dept. of Energy's Office of Fuels Development and U.S. Dept. of Agriculture's Office of Energy, NREL/SR-580-24089, p. 5: http://www.nrel.gov/docs/legosti/fy98/24089.pdf (accessed November 2007).
[9] Knothe, Gerhard, Sharp, Christopher, and Ryan, Thomas, 2005, Exhaust Emissions of Biodiesel, Petrodiesel, Neat Methyl Esters, and Alkanes in a New Technology Engine, Energy & Fuels, vol. 20, no. 1, p. 407 (published online 11/30/2005): http://www.biodiesel.org/resources/reportsdatabase/reports/gen/20051130_gen-372.pdf (accessed November 2007).
[10] R. L. McCormick and others, 2006, Effects of Biodiesel Blends on Vehicle Emissions, U.S. Dept. of Energy, National Renewable Energy Laboratory (NREL) Milestone Report NREL/MP-540-40554: http://www.nrel.gov/docs/fy07osti/40554.pdf (accessed October 2007).
[11] Bruce Heine, Magellan Midstream Partners, public testimony, September 20, 2007, before Kansas Legislature's Special Committee on Energy, Resources, and the Natural Environment.

so long as the fuel meets the American Society for Testing and Materials (ASTM) D 6751 standard for biodiesel.[12]

Concerns over quality and consistency of biodiesel have hampered acceptance of the fuel. Currently, the ASTM D 6751 fuel standard and an accompanying process quality control standard titled BQ-9000 are not mandated. As of 2007, about 40% of U.S. biodiesel plants comply with BQ-9000 to produce D 6751-compliant biodiesel, and adoption of these standards has greatly increased acceptance of biodiesel in the marketplace.[13] Moreover, biodiesel can not be sold without a valid certificate of analysis (COA), and use of the ASTM standard is mandatory if the biodiesel is blended and the blender takes advantage of the "blender's tax credit"[14] (see existing policies and programs below). Testing for ASTM compliance has been estimated at $1,000 per test.[15]

Biodiesel (B100) contains approximately 8% less energy (on a BTU-per-gallon basis) than standard #2 petrodiesel. However, because biodiesel has a greater cetane value (a measure of combustion efficiency) than petrodiesel, it is difficult to make an absolute determination on fuel efficiency (miles per gallon).[16]

Existing Policies and Programs

1. The Volumetric Ethanol Excise Tax Credit (VEETC), established under the 2004 American Jobs Creation Act, provides a $1.00 per gallon pure biodiesel excise tax credit for agri-biodiesel producers and blenders, a $0.50 cents per gallon pure biodiesel excise tax credit for biodiesel producers and blenders using agricultural products and animal fats, and a $1.00 per gallon excise tax for "renewable diesel" producers and blenders. The biodiesel tax credits will expire at the end of 2008.

2. The Renewable Fuel Standard (RFS), part of the 2005 Energy Policy Act, mandates that 4.0 billion gallons of renewable fuel be blended in 2006, increasing incrementally to 7.5 billion gallons in 2012.

3. The 2005 Energy Policy Act extended and slightly modified the existing federal production tax credit; biodiesel producers with capacity below 60 MGY receive $0.10 per gallon for the first 15 million gallons produced.

4. The Biodiesel Fuel Producer Incentive (K.S.A. 79-34,158) provides producers with $0.30 per gallon of biodiesel sold. Funding for the biodiesel incentive is $875,000 per quarter starting July 1, 2007, with a one-time payment of $437,500 added to the fund at its inception.

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[12] National Biodiesel Board, 2007, Specification for Biodiesel (B100) – ASTM D6751-07b: http://www.biodiesel.org/pdf_files/fuelfactsheets/BDSpec.pdf (accessed November 2007).
[13] Nelson, Richard, 2007, Biodiesel in Kansas—Background Report Prepared for the Kansas Energy Council: http://kec.kansas.gov/reports/Biodiesel_in_Kansas_FINAL.pdf.
[14] Richard Nelson, Kansas State University Engineering Extension, personal communication, December 2007.
[15] Adrian J. Polanksky, Kansas Secretary of Agriculture, personal communication, October 31, 2007.
[16] Richard Nelson, Kansas State University Engineering Extension, personal communication, December 2007.

5. Kansas H.B. 2038 provides 10 year property tax exemptions, accelerated depreciation over 10 years (55% the first year and 5% thereafter, and Kansas Development Finance Authority (KDFA) financing for biomass to energy projects, excluding projects using corn or grain sorghum feedstocks.

6. The Kansas Alternative-Fuel Fueling Station Tax Credit provides tax credits to distributors of renewable fuels. Alternative-fuel fueling stations in service between January 1, 1996, and January 1, 2005, qualify for 50% of total expenditures up to $200,000; stations built between January 1, 2005, and January 1, 2009, receive 40% of expenditures up to $160,000; and stations built after January 1, 2009, receive 40% of expenditures up to $100,000.

7. The Kansas Dealers Incentive Fund provides incentives to retail dealers who sell and dispense biodiesel at the pump. This fund will begin receiving quarterly payments of $400,000 on January 1, 2009, giving dealers $0.03 per gallon for biodiesel.

8. The Storage and Blending Equipment Tax Credit provides an income tax credit for equipment used to store and blend biofuels as well as petroleum-based fuels. The income tax credit of 10 percent is provided for the first $10 million of the taxpayer's qualified investment, with a 5 percent credit applied to the amount of investment that exceeds $10 million. The program applies to tax years beginning January 1, 2007, and running through December 31, 2011.

9. The Biomass-to-Energy Plant Tax Credit (K.S.A. 79-32) establishes an income tax credit for new construction or expansion of a biomass-to-energy facility. Investors get a 10% tax credit for the first $250 million invested and a 5% tax credit for any investment exceeding $250 million. The tax credit is applied over 10 years in equal annual installments.

10. A new Kansas law (K.S.A. 79-32,201) establishes an income tax credit covering up to 40% of the incremental or conversion cost of an alternative fuel vehicle (AFV).

11. Among Kansas laws targeting biofuels and state vehicles, K.S.A. 75-3744a requires that a 2% or higher blend of biodiesel be purchased for use in state vehicles, provided the cost is not more than $0.10 per gallon more than diesel. In addition, SB 262 requires the purchase of E85 vehicles when making new purchases or leases.

12. The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) provides biorefinery grants to address specific technological improvements in the refining process.

13. The 2000 Federal Biomass Research and Development Act establishes grants for research, development, and demonstration of feedstock production, cellulosic ethanol, and product diversification. The grants are administered by the Biomass Research and Development Initiative (BRDI), which is coordinated jointly by USDA and DOE.

14. The DOE offers a number of biofuels loan guarantee and incentive programs authorized by the 2005 Energy Policy Act. One program authorizes the DOE to provide loan guarantees to projects that reduce air pollution and greenhouse gas emissions, including biofuels projects.

15. The U.S. Department of Agriculture (USDA) Bioenergy Program, established by a 1999 Executive Order, reimburses biodiesel producers for commodity purchases necessary for expanding production.