CHAPTER 14
Biodiesel

INTRODUCTION

"Biodiesel" — diesel fuel made from animal or vegetable materials — is an alternative fuel that has been used in motor vehicles since the beginnings of the automobile industry. It can be substituted for petroleum-based diesel fuel ("petrodiesel") in diesel engines. Vehicles using biodiesel emit fewer pollutants than petrodiesel, although they also generally get slightly fewer miles per gallon.

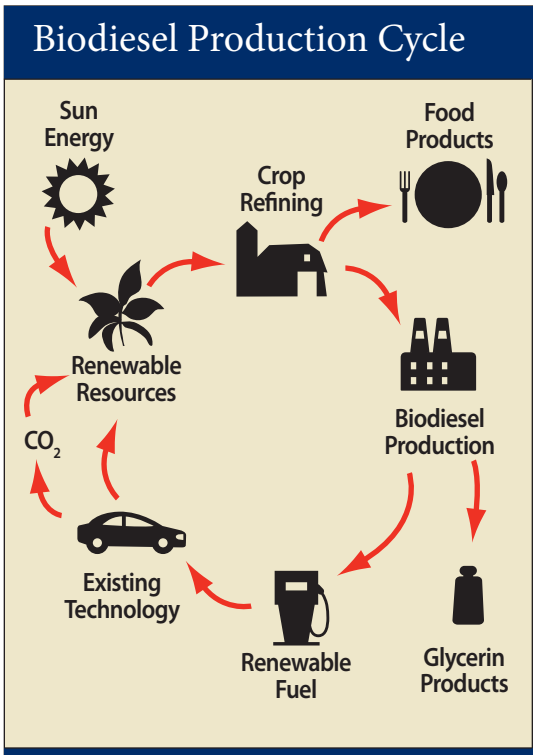
The basic process for making fuel from organic matter has not changed since it was invented in the nineteenth century. The process, called transesterification, forces vegetable oil or animal fat to react with a catalyst (usually sodium hydroxide) and methanol or ethanol to produce glycerol and fatty acid esters, the latter being the actual chemical name for biodiesel (**Exhibit 14-1**). Transesterification originally was used to obtain glycerol for soap; what we now call biodiesel was a byproduct of the soap-making process.

Many products, including peanut oil, hemp oil, corn oil and tallow (beef fat) have been used as feedstocks for the transesterification process.[1] Today, the most common sources for biodiesel are:

- plants: soybeans, peanuts, rapeseed, palm, corn, sorghum, canola, sunflower and cottonseed;
- animal fats: tallow, white grease, poultry fats and fish oils; and
- recycled greases: used cooking oils and restaurant frying oils.[2]

As the nation's largest producer of biodiesel, Texas could benefit from any future expansion in its production or use. The biodiesel industry can affect the economy through investments in construction, spending on related goods and services and jobs.

EXHIBIT 14-1



Source: PropelBiodiesel.

History

When German engineer Rudolph Diesel first demonstrated his compression ignition engine at the 1898 World Exhibition in Paris, he used peanut oil for fuel. At the time, Diesel thought that biofueled engines were a good alternative to the steam engine. In fact, diesel engines generally ran on vegetable oils until the 1920s, when the engines were first altered to allow them to use petroleum products for fuel.[3]

Diesel was not alone in his faith in biofuels. Henry Ford designed his automobiles, beginning with the 1908 Model T, to use ethanol, a fuel distilled from corn. Ford even built an ethanol plant in the Midwest and formed a partnership with Standard Oil to sell it in the company's fuel stations.

New Sources for Biodiesel

Algae

Making biodiesel from little more than sunlight and water is an attractive proposition that at first may appear to be little more than science fiction. Nonetheless, researchers have been studying this approach since the late 1970s.

Algae are single-celled organisms that, like plants, produce energy through the process of photosynthesis, converting water, sunlight and carbon dioxide into "food" in the form of an oil. This algae oil can be used to produce biodiesel for engines.[4] Extracting the oil leaves behind dried green flakes that can be further reprocessed to create ethanol, another fuel.[5]

Algae intended for biodiesel are grown in water and fed carbon dioxide waste from industrial sources such as power plants, ethanol manufacturers, refineries and cement/kiln operations.[6] The process can be used to reduce carbon dioxide emissions from power plants, and the algae also devour other pollutants.[7]

Algae are highly flexible; they can be grown in most climates, and do not require arable land for production. According to the National Renewable Energy Laboratory (NREL), "[m]icroalgae systems use far less water than traditional oilseed crops."[8] Algae can be grown in brackish water, seawater and even wastewater.

Algae are perhaps the most renewable of energy sources, since unlike most plant stocks, they can be grown throughout the year and harvested continuously.[9]

In early studies, strains of algae selected for their high oil production were grown in large outdoor open-air ponds known as "algae farms." The open nature of the farms was problematic for keeping temperatures consistently warm enough for the algae to grow, however, and for keeping other strains of algae from invading the ponds and overtaking the favored oil algae.

Bioreactors being studied today grow algae in plastic bags or tubes that let sunshine in and keep contaminants out. Production facilities are still called "algae farms," though.

In 1996, NREL ended its algal fuel research program due to a lack of funding. In October 2007, however, NREL announced that it had entered into a collaborative research and development agreement with Chevron Corporation "to study and advance technology to produce liquid transportation fuels using algae."[10] Chevron Technology Ventures is funding the initiative. Other private ventures and university partnerships concerning algal energy production are also under way.

GreenFuel Technologies of Cambridge, Massachusetts has partnered with Arizona Public Service to test algae production at the utility's natural gas-burning power plant just west of Phoenix. Solix Biofuels, an algal energy fuel company based in Fort Collins, Colorado is teaming up with New Belgium Brewery to use the carbon dioxide produced in the brewing process to feed its algae. Solix plans to build a test bioreactor on property owned by New Belgium.[11]

Valcent Products, Inc. has built an algae growing system in the El Paso area dubbed "Vertigro," not only to produce algal oil but also to test and develop the system for eventual sale to other biofuel refineries in the U.S., Europe and South Africa.[12]

South Texas will be home to a proposed research and development program to develop algae derived JP8 jet fuel. The project will be part of PetroSun's initial commercial algae-to-biofuels facility in Rio Hondo, Texas. The algae farm is estimated to produce at least 4.4 million gallons of algal oil and 110 million pounds of biomass annually.[13]

New Sources for Biodiesel (cont.)

The Texas Agricultural Experiment Station and General Atomics have received Department of Defense and Texas Governor's Office Emerging Technology Funds to demonstrate algal biodiesel production at the Texas Agricultural Research and Extension Center at Pecos. At least four different bioreactor designs will be tested with proprietary algae strains under varying conditions.

The algal process is not yet financially competitive with traditional forms of energy. In its 1996 closeout report, NREL projected that the cost for producing biodiesel from algae at that time was "two times higher than current petroleum diesel fuel costs."[14]

In 2007, the retail price of diesel is twice what it was in 1996, but companies have yet to produce algal fuel for less than the cost of other types of energy.

In addition to the sale of algae-based biodiesel, other revenue may come from the sale of "carbon credits" used by various countries in carbon trading markets intended to reduce carbon emissions. The value of such earnings cannot be estimated, but it could make algal oil production commercially viable in some jurisdictions.

Despite the financial support of these leaders of industry, the biofuels industry did not last. Extremely low prices for petroleum products in the 1920s led to their eventual domination of the vehicle industry. Today's sharp increase in oil prices, however, has spurred renewed interest in biofuels.[15]

Uses

Most biodiesel used in the U.S. fuels fleet vehicles. Hundreds of big and small fleets run on biodiesel, including those operated by the U. S. Postal Service (USPS) and the military as well as vehicles belonging to various metropolitan transit systems, agricultural concerns and school districts.[16] USPS states that its fleet of 43,000 alternative-fuel vehicles is the world's largest.[17] San Francisco's city fleet of diesel vehicles, which includes fire trucks, ambulances and buses, also runs on biodiesel.[18]

Biodiesel can be used alone or mixed with petroleum-based diesel fuel. The most common blend in current use, "B20," is 20 percent biodiesel and 80 percent petroleum diesel. B100 is pure biodiesel (**Exhibit 14-2**).

Vehicles using B100 experience a 5 to 10 percent reduction in fuel efficiency.[19] Vehicles that run on B20 have almost the same fuel efficiency as those that run on petrodiesel, experiencing a 1 to 2 percent drop that is difficult to measure.

The U.S. Army, Navy, Air Force and Marines all use B20 at bases and stations throughout the country. Of the four branches, the Marine Corps offers the most B20 locations.[20]

Biodiesel and heating oil mixes also heat homes and businesses, especially in the northeastern U.S.[21] The Warwick School Department in Warwick, Rhode Island, for instance, used various biodiesel-blended heating oils to fuel boilers in several of its schools from 2001 to 2005. When the experiment began, it was the first documented use of "bioheat" in the U.S. All schools reported an improvement in the performance of their boilers as well as a decrease in emissions.

The schools received grants and additional funding from the National Renewable Energy Laboratory to pay for the biofuel, since it cost more than regular heating oil. When NREL funding for the biofuel experiment ended in 2005, the schools reverted to conventional heating oils.[22]

Biodiesel in Texas

Texas has been the nation's leading biodiesel producer, with 72.9 million gallons produced in 2007. Much of the production is made from soybean oil from plants located in the Midwest. Current high production prices because of climbing soybean prices have slowed sales in the state and led producers to export more biodiesel to Europe.

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EXHIBIT 14-2
Biodiesel Blends

Name	Blend	Properties
B5	5 percent biodiesel 95 percent petrodiesel	Very similar to petrodiesel; generally accepted by all engine manufacturers. Reduces air pollution from unburned hydrocarbons, carbon monoxide and particulate matter, and emits lower levels of carbon dioxide than petrodiesel. Approved for use in Texas.
B10	10 percent biodiesel 90 percent petrodiesel	Reduces air pollution and emits lower levels of greenhouse gases than petrodiesel.
B20	20 percent biodiesel 80 percent petrodiesel	May cause a slight (1 percent to 2 percent) decrease in engine power and fuel economy. Lowers unburned hydrocarbons by 21 percent, carbon monoxide by 11 percent and particulate matter by 10 percent. Previously thought to cause a less than 2 percent increase in NO_x emissions, although broader, more recent studies indicate no increase on average. Approved to use in Texas with additives.
B100	100 percent biodiesel	May cause a 5 percent to 10 percent decrease in engine power and fuel economy.

Source: U.S. Department of Energy.

The U.S. National Biodiesel Board estimates that the U.S. produced 250 million gallons in 2006 and 450 million gallons in 2007.

Economic Impact

No estimate of the overall economic effect of the Texas biodiesel industry is available, although at this writing the Biodiesel Coalition of Texas is preparing estimates. As the nation's largest producer of biodiesel, Texas could benefit from any future expansion in its use. The biodiesel industry can affect the economy through investments in construction, spending on related goods and services and jobs.

Soybeans are the most common oil source for biodiesel. Biodiesel production consumes 15 percent of the U.S. soybean crop and already has raised soybean prices. Texas farmers, however, raise a relatively small amount of soybeans — 3 million bushels in 2007, compared to national production of 2.59 billion bushels in the same year or a little over one-tenth of one percent of the U.S. total.[23] Texas has no soybean crushing plants because the crop is so small. As a result, soybean oil used in Texas is imported from other states.

The effects of biodiesel production are intertwined with the boom in ethanol production and related corn price increases (see Chapter 12). Record corn prices have prompted corn producers to cut soybean plantings, just as demand for soy products is increasing in Asia. Resulting price increases have affected both human food and animal feeding costs, according to the U.S. Department of Agriculture (USDA).[24]

Consumption

The U.S. consumed more than 43.1 billion gallons of diesel in 2005; biodiesel accounted for only about 91 million gallons or 0.21 percent of that market, according to the U.S. Energy Information Administration (EIA).[25] No Texas biodiesel consumption figures are available from private associations or government agencies at this writing.

In late 2007, the cost of biodiesel production increased dramatically due to the rising costs of feedstocks. State financial incentives and subsidies were eliminated at the same time, although federal subsidies remain in place. At many retail sites, biodiesel now costs more than petrodiesel, and Texas sales have fallen in consequence. Most biodiesel produced in Texas today is exported to other states and countries.[26]

Production

The U.S. National Biodiesel Board estimates that the U.S. produced 250 million gallons in 2006

and 450 million gallons in 2007. Texas has been the largest producer of biodiesel.[27] The state's current production capacity is more than 100 million gallons annually, with another 87 million gallons in annual capacity under construction.[28] This is still a small amount, however, compared to the 7.5 billion gallons of diesel fuel Texas uses annually.[29]

According to the Texas Department of Agriculture (TDA), the state produced 72.9 million gallons of biodiesel in 2007. These data came from producers registered with TDA to receive state incentive payments described below. After funding for the state program ended, TDA stopped collecting registrations and formal reports from producers.[30] Subsequently, high costs have caused some producers to reduce production or cease operations altogether, although no comprehensive statewide data for 2008 Texas production are available.

Biodiesel can be transported by truck, pipeline or train. To keep its cost competitive with that of petrodiesel, biodiesel manufacturers tend to locate their factories near the sources of their feedstocks (farming communities) and consumers (truckers, farmers and companies that maintain vehicle fleets).

In 2006, Colonial Pipeline successfully shipped B5 from Pasadena, Texas to Linden, New Jersey in an existing pipeline previously used for petroleum, with no negative effects to the pipeline; in fact, B5 has been run through pipelines in Europe for many years.[31] This was an important test for the U.S. biodiesel industry, however, because limited capacity in the freight rail system and the cost of building dedicated biodiesel pipelines could affect the industry's growth.

Electricity generated from biodiesel can be used on site or transmitted through the power grid, just as electricity derived from any other source.

The city of Oak Ridge North became the first Texas city to run its electric generators on biodiesel in February 2007. The plant's three diesel generators run entirely on biodiesel made from vegetable oil or animal fat and can generate five megawatts of electricity, enough to service about 3,000 average homes, based on average Texas electric use in 2006.[32]

Availability

The U.S. has more than 1,000 petroleum distributors offering biodiesel and 171 plants producing it. At this writing, 60 more U.S. plants are under construction. Recent disruptions in the biodiesel market due to escalating costs may mean that some of these plans are cancelled or delayed.

EIA estimates that U.S. biodiesel production capacity will reach 1.1 billion gallons by 2008.[33] The National Biodiesel Board estimates that the nation's capacity is more than double that amount.

Texas has 22 commercial biodiesel plants and 12 additional plants under construction or being expanded, as well as about 51 retail biodiesel fueling sites (**Exhibit 14-3**).[34]

Denton's Biodiesel Industries, for instance, produces biodiesel at a plant powered by gas captured from an adjacent landfill. The plant has a production capacity of 3 million gallons a year and a contract with the city of Denton to supply its fleet with biodiesel. The plant produces B100 that the city blends to create B20.

According to Charles Fiedler, vice president of Biodiesel Industries, the plant can produce all the biodiesel it needs to fulfill its contract with the city by operating only one day a week. As sales increase, so will production.[35]

About half of all U.S. biodiesel producers use soybean oil exclusively; the rest also use other fats or oils as well, including recycled cooking grease.[36] According to the National Academy of Science, "Even dedicating all U.S. corn and soybean production to biofuels would meet only 12% of gasoline demand and 6% of diesel demand."[37]

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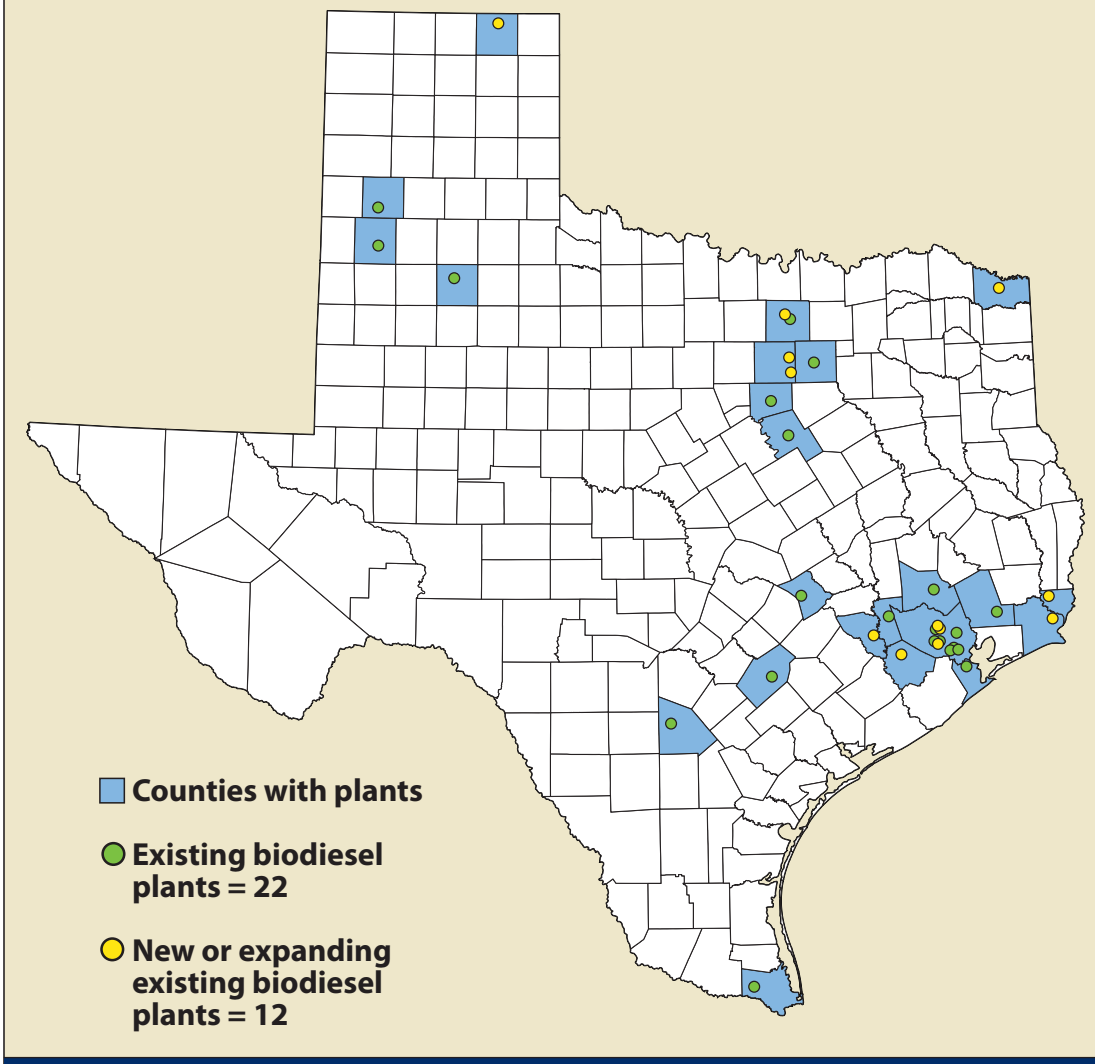
Costs and Benefits

To be a useful substitute for fossil fuel, biofuels must be price-competitive and available in quantity, and the energy used to produce them should not exceed the energy they provide. The "net energy balance" for soybeans, the most common feedstock for U.S. biodiesel, is quite high; according to the National Academy of Sciences, soybean diesel produces 93 percent more energy than is used in making it.[38] Biodiesel's major disadvantage is its high cost, primarily due to the cost of feedstocks.[39]

Biodiesel production became economically competitive with petrodiesel only with federal

EXHIBIT 14-3

Texas Biodiesel Plants



Source: National Biodiesel Board

incentives and after recent, sharp increases in the cost of petroleum. According to the latest EIA figures from January 2008, the nationwide cost of blended biodiesel (B20) was $3.37 per gallon, while B100 cost $3.69 per gallon. In EIA's Gulf Coast region, which includes Texas, the average cost of B20 was $3.37 per gallon and B100 was $3.19 per gallon, versus $3.30 for gallon for petrodiesel.[40] This includes the $1 per gallon federal tax credit provided to biodiesel.

Recent sharp increases in the price of feedstocks have pushed up production costs. Petrodiesel prices have risen, but not enough to make biodiesel cost-competitive. The cost of the feedstock oil or fat is the most expensive part of biodiesel production. For the 2007-08 season, USDA forecast that soybean prices would be at an all time high of $9.90 to $10.90 per bushel.[41] But as of January 15, 2008, USDA put the price of soybeans at $11.00 per bushel. By comparison, in December 2006, soybeans were selling at $6.14 per bushel.[42]

As a result, the cost of soybean oil, the raw material most often used to produce biodiesel, has more than doubled and has ranged up to 65 cents per pound, above USDA forecasts of prices ranging from 45.9 to 49.5 cents per pound. Each gallon of biodiesel requires 7.35 pounds of soybean oil.[43]

For this reason, today it is difficult to produce and sell biodiesel on a competitive price basis in Texas, even including subsidies. The cost of the soybean oil needed to produce a gallon of biodiesel was over $4.00, excluding costs for production and transportation. So even with a $1.00 per gallon federal tax credit, biodiesel producers face a difficult market.

Again, while Texas is a minor producer of soybeans, they are the preferred feedstock for most Texas biodiesel producers. As the price of soybeans continues to increase, and local access to soybeans in Texas remains limited, Texas biodiesel producers are looking to alternative feedstocks such as other oilseed crops and used cooking oil.[44] Since most soybean supplies are shipped to Texas from the Midwest, Texas biodiesel producers are trying to cut costs by using local feedstocks that do not have to be shipped for long distances.

Environmental Impact

The U.S. Environmental Protection Agency (EPA) and the National Renewable Energy Laboratory (NREL) have studied the effect of biodiesel on vehicle emissions. According to these sources, biodiesel has fewer noxious emissions than petrodiesel. Test results for B20 found that using it in the place of petrodiesel lowered unburned hydrocarbons by 21.1 percent, carbon monoxide by 11 percent and particulate matter (soot) by 10.1 percent. In addition, biodiesel's CO_2 emissions are lower than petrodiesel's.[45]

Some controversy has arisen, however, over the amount of nitrogen oxide emissions produced by burning biodiesel. In a 2002 EPA study, biodiesel produced 2 percent more nitrogen oxide (NO_X) emissions than petrodiesel.

NO_X is the generic term for a group of highly reactive gases, all of which contain nitrogen and

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Biodiesel Byproduct Becomes Energy

Turning biodiesel waste into fuel could be the economic and ecological equivalent of spinning straw into gold. Glycerin, a natural waste byproduct of biodiesel production, is a clear, viscous, nontoxic, sweet-tasting liquid used in cosmetics, soaps, food production and pharmaceuticals. Even with its broad variety of uses, however, the production of glycerin is exceeding demand.

As the amount of biofuel produced increases, so does the amount of glycerin. Every ten pounds of biodiesel produced yields one pound of glycerin.[46] Glycerin has rapidly moved from being a revenue-producing commodity to a waste product with a "disposal cost associated to it."[47] Dow Chemical reportedly closed its synthetic glycerin plant in Freeport, Texas in 2006 due in part to "the flood of glycerin from U.S. biodiesel plants."[48]

But researchers worldwide are searching for ways to turn a profit from the glycerin glut. Studies are under way to turn crude glycerin into bio-based chemicals that can be substituted for petrochemicals in products such as soil treatments, paints, lubricants and antifreeze.

Using a $2 million grant from USDA and the U.S. Department of Energy, Virent Energy Systems, Inc. is working to improve the process for making propylene glycol (PG), a chemical used in a number of industrial processes, from glycerin.[49]

A Vienna, Austria research firm, eTEC Business Development, Ltd. is converting glycerin into electricity by burning it in specially designed engines.

And Organic Waste Systems, a Belgian biogas firm, is developing a methane digester system to produce biogas from crude glycerin; the system would allow a commercial-scale biodiesel facility to generate its own power with waste glycerin.[50]

oxygen in varying amounts. Many nitrogen oxides are colorless and odorless. One common pollutant, however, nitrogen dioxide (NO_2), often is seen as a reddish-brown smog layer over urban areas.

Nitrogen oxides form when fuel is burned at high temperatures. The primary manmade sources of NO_X are motor vehicles, electric utilities and other industrial, commercial and residential sources that burn fuels. NO_X also can be formed naturally in the ozone layer of the atmosphere (the troposphere). It is one of the main ingredients in the formation of ground-level ozone, which can trigger serious respiratory problems in some people.[51]

In November 2005, the Texas Commission on Environmental Quality (TCEQ) adopted emission standards for all diesel, petro- or bio-, sold in 110 counties facing the most severe challenges from air pollution (primarily in the eastern half of Texas, including Austin, San Antonio, Houston and Dallas). The goal of these Texas Low Emission Diesel Fuel Standards (TxLED) is to reduce nitrogen oxide and other pollutants from diesel-powered vehicles and non-road equipment. It did not immediately approve use of biodiesel because of concerns over NO_X, however.[52]

According to NREL, biodiesel has fewer noxious emissions than petrodiesel.

Subsequent tests by NREL and other groups found that biodiesel did not contribute to higher NO_X emissions. A 2006 NREL study stated, "we conclude that B20 has no net impact on NO_X."[53]

In testimony prepared for the Senate Natural Resources Committee of the Texas Legislature, NREL staff outlined their findings. The key difference between the EPA and NREL studies was that the earlier EPA study used one engine model to derive almost half of its data. The NREL study used 43 different engines and found that the change in NO_X varied from plus 4 percent to minus 4 percent but on average was 0 percent. NREL's testimony highlighted similar results from 2005 and 2006 Texas A&M University, the U.S. Navy and other university studies. In light of these developments, Texas biodiesel producers asked TCEQ to study biodiesel again and approve its use in Texas.

As a result, in December 2006, TCEQ announced that it would conduct a year-long study of biodiesel emissions to determine whether B20 meets TxLED and stated that it would delay implementing the standards until December 31, 2007. On December 21, 2007, TCEQ and the EPA announced that B5 meets the TxLED emission standards and can be used in diesel vehicles. At this writing, however, TCEQ has not approved the use of B20 blends unless specific chemical additives are included in the fuel.[54]

Growing crops for biodiesel may require substantial amounts of water: water use for irrigated soy crops averages 45,000 gallons per million Btu of energy produced. Biodiesel processing uses only 4.2 gallons per million Btu.[55]

Even though most biodiesel manufacturing plants use fossil fuels to run their operations, biodiesel is still an energy-efficient fuel. The U.S. Department of Energy has observed:

> You get 3.2 units of fuel energy from biodiesel for every unit of fossil energy used to produce the fuel. That estimate includes the energy used in diesel farm equipment and transportation equipment, fossil fuels used to produce fertilizers and pesticides, fossil fuels used to produce steam and electricity and methanol used in the manufacturing process.[56]

Other Risks

Biodiesel contains residual alcohol from the esterification process that can remove deposits from fuel tanks and lines, causing filter plugging when it is used initially. Fuel systems should be flushed before using biodiesel, and fuel filters may need more frequent replacement when it is first used in older vehicles.

Low temperatures can affect B100 biodiesel during storage and operation, causing it to begin to solidify. At such temperatures, the fuel may need to be stored in a heated building or storage tank, and the engine itself may require heated fuel lines, filters and tanks.

Petrodiesel also may solidify in cold weather, but petroleum companies and distributors manage the fuel inventory and additive treatments based on the history of the fuel's performance in each geographical region throughout each season, so the right blend of diesel fuel is available at the right time of year, allowing consumers to avoid

cold flow problems.[57] Biodiesel distributors hope to develop the same system for biodiesel once the market becomes more established across the country.

Biodiesel has a flash point — the temperature at which it will ignite when exposed to a spark or flame — of 150° C. This means that it is safer to store and handle than petrodiesel fuel, which has a flash point of 70° C.[58]

Biodiesel has a tendency to absorb and attract water, so it must be stored in tanks that are free of water and do not absorb it. Above-ground tanks are preferable, since they are not readily contaminated by groundwater. Otherwise, biodiesel stores nearly as well as petrodiesel.[59] Biodiesel may be stored (in the dark and at a cool temperature) for up to eight months before it begins to degrade. Petrodiesel has a longer shelf life; it can be stored for up to one year before it begins to degrade.[60]

Since biodiesel can be stored in tanks currently used to store petrodiesel, little or no additional storage cost is involved in converting from one fuel to the other. The same regulations and monitoring are required for both fuels.

One potential problem is that biodiesel can react chemically with the rubber seals in vehicle fuel systems. This is a slow process, however, and one that usually can be avoided by adhering to normal maintenance schedules. Also, many engine manufacturers now use silicone rather than rubber seals to avoid any problems with biofuels.[61]

Engine Warranties

Engine companies generally recommend a fuel to their customers in their owner's manuals. Since they do not make or sell fuel or fuel components, they do not provide warranties for fuel, including petrodiesel and biodiesel. Engine problems caused by fuel are considered the responsibility of the fuel supplier rather than the engine manufacturer. Most major engine companies, however, have approved the use of diesel blends of up to B20 and will not void their parts and workmanship warranties if the blend is used.

The American Society for Testing and Materials, an internationally recognized standards organization, sets standards for fuels. These standards are the minimum accepted values for fuel properties to provide adequate customer satisfaction and protection. In December 2001, ASTM approved a full standard for biodiesel, D-6751, which covers B100 for blending with petrodiesel in levels of up to 20 percent (B20, in other words). The ASTM standard gave the biodiesel industry the approval it needs to be widely accepted by engine manufacturers and consumers.[62]

Some engine companies state that biodiesel must meet ASTM D-6751 as a condition; others are in the process of adopting D-6751 or have their own guidelines for biodiesel that were developed before the standard's approval. The entire industry is considering incorporating the ASTM biodiesel standard into owner's manuals over time.[63]

The National Biodiesel Board, the trade association for the biodiesel industry, has formed the National Biodiesel Accreditation Commission (NBAC) to audit fuel producers and marketers in order to improve the quality of biodiesel production and handling. NBAC issues a "Certified Biodiesel Marketer" seal of approval for biodiesel marketers that have met all requirements of its fuel accreditation audits.[64]

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State and Federal Oversight

Several federal agencies regulate the biodiesel industry:

- USDA – research and development of biofuels;
- DOE – alternative fuel regulations;
- EPA – emission testing and air quality permits;
- U.S. Department of Transportation – alternative fuel regulations;
- U.S. Department of the Treasury – tax credits, incentives and subsidies; and
- U.S. National Institute of Standards and Technology – alternative fuel standards.

In addition, four state regulatory agencies and departments monitor biodiesel in Texas:

- TCEQ – environmental permits;

- Texas Department of State Health Services – renderer licensing (renderers supply feedstock to biodiesel plants);
- TDA – biodiesel plant registration and monitoring for the state's Fuel Ethanol and Biodiesel Grant program; and
- Texas Comptroller of Public Accounts – supplier and distributor licensing.

Subsidies and Taxes

The federal government provides tax breaks and other incentives for the biofuels industry.[65] EPA, for example, administers the Renewable Fuels Standard (RFS), which requires U.S. fuel blenders to increase their use of renewable fuels from 4 billion gallons in 2006 to 9 billion gallons by 2008 and 36 billion gallons by 2022.[66] Under new legislation, the RFS for biodiesel will increase from 500 million gallons in 2009 to 1 billion gallons by 2012.[67]

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DOE and USDA also provide loans and research funding to develop and promote the biofuel industry. The most important subsidy is the $1 per gallon federal credit that blenders receive for every gallon on B100 they combine with petrodiesel.[68] For a more complete explanation, see Chapter 28.

The Texas Department of Agriculture has administered the state's Fuel Ethanol and Biodiesel Production Incentive Program since 2006. Texas biofuel producers registered with TDA are eligible for state grants based on the amount of fuel they produce. Qualified producers receive 20 cents per gallon of ethanol or biodiesel produced, limited to the first 18 million gallons produced annually for the first 10 years. Registered biodiesel producers pay 3.2 cents per gallon into the pool of funds while the state provides 16.8 cents per gallon.

Since the program began to pay producers in May 2006, it has distributed $11.5 million in funding, $9.6 million of which is state money. The 2007 Texas Legislature extended the program but did not appropriate any further funding for it. The program made final payments in November 2007 for production during the state fiscal year ending in August 2007.[69]

Texas also provides a diesel fuel tax exemption for biodiesel and ethanol, as well as biodiesel or ethanol blended with taxable diesel, if identified as such at the point of sale.[70] The tax is paid on the percentage of petrodiesel used in the biofuel. If the biodiesel is B20, for instance, tax is paid on 80 percent of each gallon. No tax is levied on B100 purchased in Texas.[71]

The 2007 legislative session approved two bills affecting the biodiesel industry, H.B. 2417 and S.B. 12. H.B. 2417 formally moved the Fuel Ethanol and Biodiesel Production Incentive Program from the Governor's Economic Development and Tourism Office to TDA. Previously, TDA operated the program under contract with the Governor's Office. Again, however, the program received no funding in 2007 and is no longer active.

One 2007 bill relating to programs to improve air quality, S.B. 12, was funded. One of the bill's programs, the Emissions Reduction Incentive Grants Program, provides funds to projects that reduce emission of NO_X from diesel vehicles. Another, the New Technology Research and Development Program, provides grants to research projects that find ways to reduce pollution in Texas.[72] For more information, please refer to Chapter 28.

Other States and Countries

At least seven states have enacted renewable fuels standards to help increase the availability of renewable fuels. Minnesota was one of the first states to encourage the use of biofuels and now requires that 2 percent of all diesel fuel sold in the state must be biodiesel. In March 2007, the state of Washington passed a similar mandate requiring that 2 percent of all diesel fuel sold annually must be biodiesel by November 2008 or whenever the state's Department of Agriculture determines there is enough feed-stock grown in the state.[73]

In 2003, Illinois began its Renewable Fuels Development Program (RFDP), which provides grants for the construction of new biofuel production facilities. The state has 53 million gallons of annual biodiesel production capacity, with 35 million gallons of additional capacity under construction. RFDP awards grants of up to $5.5 million to projects that have a minimum annual production capacity of 30 million gallons. Illinois also has 144 biodiesel dispensing stations.[74]

Polytechnic University in Brooklyn, New York, has created a plastic made from soybeans that can be turned into biodiesel. This invention could be helpful to soldiers in the field who could use the plastic for packaging and then as fuel. It would reduce the waste the military creates as well as the amount of fuel it must transport.[75]

Europe

Biodiesel is the European Union's (EU's) most important biofuel, representing almost 80 percent of its total biofuel consumption. (Ethanol accounts for the remaining 20 percent.) The EU is the world's biggest consumer of biodiesel, in part because almost half of the cars and trucks in the EU have diesel engines.[76]

Biodiesel production in European countries began in earnest in 2003. The EU Common Agricultural Policy includes a set-aside program that pays farmers not to plant food or feed crops on a portion of their arable cropland; they are, however, allowed to plant rapeseed, sunflowers or soybeans for industrial purposes. This encouraged the growth of the European biodiesel industry.[77]

In 2003, the EU set a goal that by the end of 2005, biofuels should account for 2 percent of the energy used by member nations for transportation. At the end of 2005, the actual share attributable to biofuels was 1.4 percent. The European Council, the EU's governing body, has now suggested a new goal of 8 percent by 2015, with the hope of reaching a 25 percent share for biofuel by 2030.[78]

The EU had 20 biodiesel-producing countries in 2005, compared to 11 in 2004. Production has increased sharply, rising by 65 percent between 2004 and 2005 alone. Total EU biodiesel production rose from 2.9 million tons in 2005 to 6.1 million tons in 2007.[79]

"Detaxation" (an EU term for a reduced level of taxation, in this case compared to petroleum-based fuel) offers very strong incentives for biofuel production. EU member states have different detaxation systems affecting the development of biofuels. Germany has been a pioneer in using these incentives to promote the use of biofuels, and their use has grown rapidly in that country. In June 2006, however, the German government reduced the tax benefit for biofuels, and the rate of biodiesel production decreased.

At present, the EU is in a state of overcapacity for biodiesel, particularly in Germany, where the tax incentives were most favorable. Too many biodiesel plants were built and too much biodiesel was produced. Germany increased the taxes on biodiesel in 2007, adding to the fuel's already high cost. At the beginning of 2008, the German biodiesel industry was producing at only 10 percent of its capacity.[80]

In addition, Europeans are complaining about what they call dumping by American biodiesel producers who export their product to Europe while benefiting from the $1 per gallon tax credit.[81]

Asia

In India, a pilot project is running five to ten mobile base stations for wireless communications on biodiesel derived from cottonseed and jatropha.[82] The seeds of jatropha, a plant that originated in South America, can be crushed to produce oil that has been used for centuries in oil lamps.

Some companies and scientists believe that jatropha could become one of the world's key energy crops, since its oil can be refined into biodiesel.[83] Under optimum conditions, jatropha seeds can yield up to 40 percent oil content. Since it is inedible, it does not compete as a food source. Tests have shown that the oil's characteristics are favorable for biodiesel.

Jatropha grows in tropical and subtropical regions. It is hardy and relatively drought-resistant. The trees have a lifespan of 30 to 40 years. Jatropha grows on non-arable, marginal and waste land, and need not compete with food crops for good agricultural land.

One of its downsides, however, is the labor-intensive process needed to harvest the jatropha seed pods. At present, while many countries are experimenting with jatropha plants for biofuel, the only countries currently using them for biodiesel production are developing nations with relatively large and cheap labor forces.[84]

Brazil

Brazil is a global leader in the use of renewable fuels. Ethanol has long been the nation's primary biofuel, accounting for almost 40 percent of car fuel sales. Brazil's biodiesel industry is still young, but is expected to grow quickly since a January 2005 government mandate requires all diesel fuel

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to include 2 percent biodiesel beginning in 2008, rising to 5 percent in 2013.

Under current law, Brazil's potential market for biodiesel is estimated at 222 million gallons per year for 2006 and 2007; 264 million gallons per year for 2008 through 2013; and 634 million gallons per year thereafter.[85]

Outlook for Texas

Texas is the nation's leading producer of biodiesel. It has some local supplies of feedstock (although only a minimal amount of soybean production) and a large consumer base. As of 2006, 528,705 diesel vehicles were registered in Texas, and many farm and industrial vehicles run on diesel as well.[86] Federal policy changes to renewable fuel standards, combined with growing concerns about energy security and environmental change, may improve the outlook for biodiesel because it is domestically produced, renewable and has an excellent environmental profile.

The industry in Texas, however, faces significant obstacles. Rapid increases in the cost of soybean oil, all of which has to be imported into the state, have made the economics of producing biodiesel very difficult, despite the $1 per gallon federal credit. As a result, some plants have cut production or gone out of business. Most Texas biodiesel is exported to Europe and looming taxation and trade fairness issues with European countries could affect that market as well.

The Texas biodiesel production industry also experienced a setback when the Legislature eliminated funding for the Biofuels Incentive Program. The 2009 Legislature may revive the program, but a biofuel plant must remain in business until then to benefit from the incentives.

Furthermore, even though TCEQ has stated that B5 meets the state's emission standards, it has not approved the more common B20 blend without certain chemical additives. This may affect the biodiesel market and the sale of biodiesel in Texas even if feedstock cost issues, the biggest hurdle facing this fuel, are resolved.

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