Biodiesel Fleet Applications

Notes

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Introduction

There are many options available for fleet managers who wish to convert their fleets to alternative fuel vehicles. The previous section provided an overview of alternative fuel options and their benefits and drawbacks. This section will provide information specific to the use of biodiesel as an alternative fuel.

The use of biodiesel as an alternative fuel has increased over the past several years. The biggest obstacle to the widespread adoption of biodiesel is the production and widespread availability of biodiesel blends. Unlike other alternative fuels, conversion of the current fuel distribution network would require little modification.

The goal of this chapter is to provide the information necessary for fleet managers to determine if using vehicles fueled by biodiesel is a viable alternative for their fleet.

Objectives

- Explain how to implement green fleets
- Learn about incentives for converting to biodiesel fleets
- Learn about the availability and cost of biodiesel fuel
- Identify the advantages of using biodiesel
- Understand how to safely handle biodiesel

Greening of Fleets

There can be challenges to starting a green fleet, or converting an existing fleet to the use of alternative fuels. According to some industry experts, a successful plan to reduce fuel consumption and carbon emissions requires a long-term vision, incremental change, support from top management, and flexibility to make changes along the way.

There are compelling reasons *why* fleets should be green and deliberate steps on *how* to implement alternative fuels.[1]

Why Use Green Fleets?

- **Reduce operating costs** by improving efficiency, reducing life cycle costs, and reducing vulnerability to volatile fuel prices.
- **Reduce greenhouse gas emissions** by implementing the use of biodiesel in vehicles, which are the primary source of greenhouse gases and urban air pollution.
- **Improve corporate image** by branding business strategies and appealing to public concerns about energy conservation and ecological sensibilities.

How to Implement Green Fleets

- **Get buy-in** from all management and staff levels, and be sure to communicate information about the benefits, goals, and targets frequently.
- **Create long-term objectives** and tangible goals based on best practices in the industry (such as baselines, benchmarks, and progress reports).
- **Avoid setting reduction goals in absolute numbers** for growing fleets or fleets just starting because absolute goals can impede growth.
- **Anticipate obstacles**, such as driver resistance, lag time between original equipment manufacturers' technology and market availability, and slower return on investment.
- **Move slowly** and implement change over time.
- **Improve vehicle use** with selection analysis and education of drivers.
- **Track and report progress** and share successes with employees, shareholders, and the public.

Biodiesel Fleets

Conventional diesel fuel is a refined petroleum product. It is subject to the same concerns as gasoline: its exhaust emissions pollute the environment, and dependence on foreign supplies of petroleum threatens economic security.

The alternative to diesel is a fuel made from natural products called biodiesel. Biodiesel is a domestically produced renewable fuel that can be manufactured from organic materials. Its physical properties are very similar to those of diesel, yet biodiesel burns much cleaner with fewer emissions.

Biodiesel can be derived from a variety of feedstock sources such as vegetable oil, soybean oil, canola oil, rapeseed oil, palm oil, recycled cooking oil, or beef tallow. New research has recently supported a race between companies to commercially produce algae, and its component lipid oils, as a feedstock for biodiesel. Soy methyl ester diesel (SME) is derived from soybean oil and is a common biodiesel used in the United States.

Notes

Did You Know?

Hundreds of U.S. fleets, representing more than 25,000 vehicles for commercial, government, utility, and transit use, currently run on biodiesel blends nationwide.

Source: Biodiesel.org

Blends of biodiesel and conventional diesel are commonly available throughout the country. Currently, the most common blend of biodiesel in the U.S. is B20, a blend of 20% biodiesel and 80% diesel. B5 (5% biodiesel and 95% diesel) and B2 (2% biodiesel and 98% diesel) are other common blends found at fueling stations today and may not even be labeled as blends.

Biodiesel blends are being used in a number of heavy-duty vehicles (see **Figure 1**) like buses, military support vehicles, and farm equipment. Many school districts and city fleets also are converting to biodiesel. Use of biodiesel in light-duty vehicles, however, is less common mainly due to the low volume of light-duty vehicles. Most vehicles that use diesel fuel made from petroleum (diesel) can also use biodiesel, and only minor modifications may be necessary in older vehicles.

There are many benefits in expanding the use of biodiesel to fuel light-duty fleet vehicles. These include the betterment of health and environment, efficiency of economy, sustained strategic energy security, and reduced dependence on foreign oil.

Figure 1: *Biodiesel-fueled bucket truck. Source: AFDC.*

Pure (100%) biodiesel is a nontoxic, biodegradable, sulfur-free renewable fuel. Since biodiesel can be produced domestically from renewable resources, it is nearly carbon neutral. Biodiesel can be refined at plants in this country, promoting energy self-sufficiency and creation of new jobs. Biodiesel has already carved out a sizable niche in the fuel production industry. In the near future, it is likely that even higher concentrations of biodiesel will be found at fueling stations. As production increases and cost lowers, fleets will continue to adopt biodiesel as one of their alternative fueling sources.

Incentives for Using Biodiesel in Fleets

Incentives propagate economies of scale needed for viable commercial markets. Incentives include partnership initiatives and pooled resources, financial subsidies, and informational tools. The following section discusses incentives available to fleet managers that augment efforts to implement use of biodiesel in their fleets.

Recent industry surveys have confirmed that fleet operations are voluntarily purchasing alternative fuel vehicles to meet specific EPAct regulations and mandates by the federal government. Unfortunately, alternative fuel and advanced technology vehicles cost more than their conventional counterparts, and determining how to pay for these more expensive vehicles has become a growing concern for fleet managers across the country. Fortunately, there is financial help available.

Despite the fluctuating economy and budget woes, there are a record number of grants and incentives available for funding alternative fuel vehicles. For example, in 2009, the U.S. Department of Energy (DOE) made nearly $300 million of American Recovery and Reinvestment Act (ARRA) funding available through the Clean Cities program. This single grant funding opportunity is responsible for putting more than 9,000 alternative fuel and energy efficient vehicles on the road and establishing 542 fueling stations across the country.

Tax Incentives

In 2005, the Internal Revenue Service issued a tax credit for the use of biodiesel. The credit amounted to $1.00 per gallon of agri-based biodiesel (produced from virgin vegetable oil) and $0.50 per gallon for biodiesel made from recycled cooking oil.

Federal Grant Funding

When it comes to grant opportunities, the federal government is by far the largest and most consistent source of funding. Many federal agencies offer funding opportunities, but the majority of funding for alternative fuel vehicles and transportation related projects comes from a handful of federal agencies, such as the U.S. Department of Energy (DOE), Department of Transportation (DOT), Environmental Protection Agency (EPA), and U.S. Department of Agriculture (USDA). These agencies have information on their funding opportunities available on their respective websites.

State Grant Funding

Many states have developed aggressive grant funding programs during the past few years. While each state has different grant funding sources, the designated State Energy Office (SEO) is typically the largest alternative fuel vehicle grant funding source in each state. To make it easy to identify each state's SEO, the National Association of State Energy Officials (NASEO) publishes a directory of State Energy Offices online. The DOE's Alternative Fuels Data Center (AFDC) also publishes an interactive web-based map that allows users to click on any state to get information on alternative fuel vehicle incentives and funding sources.[2] There is a multitude of state-level funding programs for clean air vehicle and transportation projects, but visiting the NASEO and AFDC websites will provide the starting points for any fleet manager interested in state-level funding programs.

Tools to Help!
Every state has some form of tax credit or rebate for using alternative fuels.
To find state-specific tax incentives, *visit: www.afdc.energy.gov/afdc/laws/search*

Incentives for Biodiesel Production

The USDA, through its Farm Service Agency, supports the Biomass Crop Assistance Program (BCAP). The BCAP provides financial assistance to owners and operators of agricultural and non-industrial private forest land who wish to establish, produce, and deliver biomass feedstocks. The BCAP provides two categories of assistance: The USDA also supports the Feedstock Flexibility Program for Bioenergy Producers, which encourages the domestic production of biofuels from surplus sugar.

Did You Know?

Federal incentives are available for producers of bioenergy feedstock.

To learn more, visit:
www.afdc.energy.gov/afdc/laws

Biodiesel Availability and Cost

Biodiesel has widespread availability around the globe. Most metropolitan transits in Australia use a B5 blend or better, Brazil opened a commercial biodiesel refinery in 2005, the industry continues to grow in China and Southeast Asia, and production has mushroomed in places like Estonia, France, and Costa Rica. Eighty-five percent of global biodiesel comes from the European Union. Germany is known as the biggest biodiesel market in the world and has a production capacity surpassing one million metric tons annually.[3]

The availability of vehicles that operate on B2, B5, and B20 blends of biodiesel continues to grow alongside increased retail availability of biofuels across the United States (see **Figure 2**).

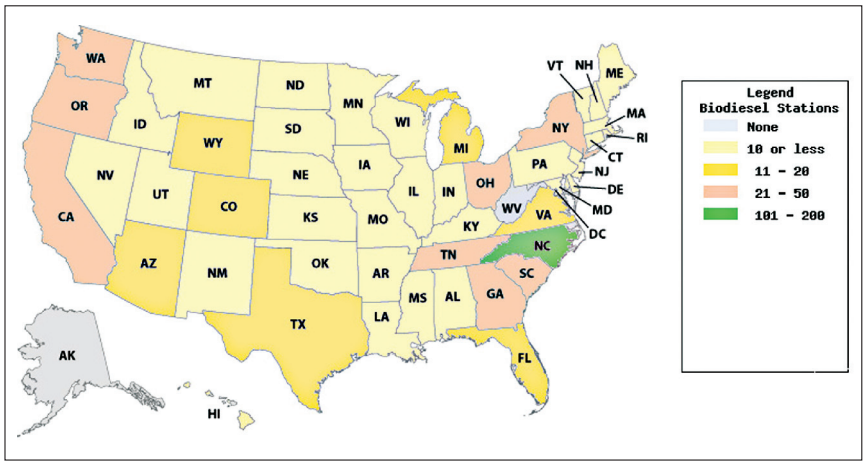

Figure 2: *Biodiesel fueling stations. Source: AFDC.*

The per-gallon cost of biodiesel is slightly more than conventional diesel because demand is low. According to the Energy Information Administration (EIA), the U.S. has significant biodiesel refining capacity and operates at about 20% production capacity, whereas petroleum refineries operate at approximately 90% capacity and are consistently pressed to make capital improvements to their operations due to market demand and emission laws. The benefits of biodiesel are growing, and as economies of scale produce more demand, prices will come down. In 2009, the difference between diesel and B20 was $0.22, and the difference between diesel and B100 was $1.00. By 2012 the difference has narrowed to $0.09 between diesel and B20, and $0.34 between diesel and B100. Fluctuations will still occur, but biodiesel is becoming more competitive in the fuel market (see **Figure 3**).

Fuel	Area	2012 Cost	2009 Cost
Diesel ($ per gallon)	National Average	$3.86	$2.19
Biodiesel (B20) ($ per gallon)	National Average	$3.95	$2.43
Biodiesel (B99-B100) ($ per gallon)	National Average	$4.20	$3.42

Figure 3: *Diesel and biodiesel cost comparison, 2009-2012. Source: AFDC.*[4]

Costs of biodiesel, just as conventional diesel, depend on a variety of factors. First, cost depends on the biodiesel blend. A high biodiesel ratio, B20 or B100 for example, will cost more. The amount of diesel in the blend also affects the price. With a dip in petroleum prices, a low bio-blend like B2 will manifest cheaper prices through the use of higher blends like B20. Secondly, the feedstock used to produce biodiesel also affects prices. The use of yellow grease (an animal feed additive also used in the production of soaps) for example, is a cheaper base product than soybean oil. Third, many agricultural crops that supply raw materials for biofuels production are based on seasonal weather. During periods of inclement weather, feedstocks tend to increase in cost and likewise affect biodiesel production costs. Finally, cost is affected by processing and distribution. Refining capacity and refining location relative to the location of an end user can increase (if refining is farther away) or decrease (if refining is closer) fuel costs.

Biodiesel Cost Summary

- *Amount of petroleum used in blend*
- *The feedstock or raw material used to produce biodiesel*
- *Seasonal weather effects on agricultural production*
- *Processing and distribution expenditures*

Biodiesel Advantages

There are advantages and things to consider when using biodiesel as an alternative fuel. Below is a list of factors that affect decisions to use biodiesel in fleets.[5]

Advantages

- Produced domestically from renewable resources
- Can be used in most diesel engines, especially newer ones (model year 1994 and newer) with little-to-no modification
- Fewer emissions of both particulate matter and greenhouse gases
- Requires no new fueling infrastructure
- Will create a new job sector and help support local economies
- Operations help rural development
- Biodegradable
- Nontoxic

Things to Consider

- Use of blends above B5 may not yet be warranted by automakers
- Lower fuel economy and power (10% lower for B100, 2% for B20)
- Currently more expensive than conventional diesel fuel
- More oxides of nitrogen emissions
- Higher blends not suitable for use in low temperatures
- Concerns about higher blends' impacts on engine durability (rubber seals, fuel lines, etc.)

Biodiesel Performance and Safety

Major considerations in the successful application of alternative fuels are performance and safety. Using alternative fuels in fleets should not sacrifice operating performance and should provide a safe alternative to conventional fuel.

Performance

Biodiesel can help meet environmental and energy security needs by reducing emissions and providing energy from a renewable source. The National Biodiesel Board (NBB) claims that biodiesel blends perform similarly to conventional diesel in terms of fuel consumption, horsepower, torque, and haulage rates; and it can be used in most engines with little or no modification to engines and infrastructure.[6]

Biodiesel Performance Summary

- *Similar horsepower to diesel*
- *Natural lubricant*
- *Cleans engines*
- *Faster ignition*
- *Poor cold flow properties*

Notes

Biodiesel also provides an increased level of lubricity that can add to the life of engines through lubrication. Most engines built after 1994 have components, like synthetic seals and rigid fuel injectors that are suitable for use of biodiesel blends up to B20. Manufacturer specific information should be referenced before use of various biodiesel blends in their equipment.

Fleet managers must anticipate the need to change fuel filters after the first tank of biodiesel runs through their vehicles. This is especially relevant for higher biodiesel blends like B20. Operating biodiesel in vehicles for the first time, after operating on conventional diesel, will result in a fuel system cleaning effect that clogs fuel filters. When this is properly anticipated and fuel filters are replaced (up to three times after initially running biodiesel) maintenance becomes the same as conventional diesel. Along with cleaning properties, biodiesel has a faster ignition due to its higher cetane properties. More rapid auto ignition correlates with fewer harmful emissions.

Cold weather is one of the biggest concerns for fleet managers when using biodiesel. Cold temperatures cause biodiesel and conventional diesel to thicken like conventional diesel. Cold flow properties refer to the cloud point and cold filter plugging point. Cloud point refers to the temperature at which biodiesel begins to crystallize and become cloudy. Cold filter plugging point is the temperature at which vehicles will not operate. Pour point is the temperature at which biodiesel has gelled and does not flow. During cold weather operations, fleet managers must identify the cold filter plugging point and plan accordingly for cold flow properties.

Different blends of biodiesel will have different cold flow properties. Lower biodiesel blends, like B2 and B5, generally have no problems with cold weather operation. Pure B100 biodiesel, and biodiesel blends like B20 have worse cold flow properties. These fuels will need cold flow treatments during colder periods, such as a fuel tank heater. According to the National Biodiesel Board, the diesel industry has met cold flow challenges with a variety of practices.

Biodiesel Cold Flow Preparation[7]

- *Pre-winter planning with fuel and additive suppliers for appropriate blends*
- *Use of kerosene or cold flow additives*
- *Incorporating biodiesel blends of less than 20% into existing biodiesel stock*
- *Storage of vehicles in or near buildings*
- *Utilization of fuel tank, fuel filter, and fuel line heaters*

Safety

Biodiesel is a relatively safe alternative fuel when compared to conventional diesel. Biodiesel is environmentally friendly with fewer greenhouse gas emissions while demonstrating nontoxic and biodegradable properties. Biodiesel vapors are less combustible than diesel.

Biodiesel is more biodegradable and has a higher flash point than conventional diesel. Within 28 days, pure biodiesel degrades 85-88% in water. Blends of 20 and 80% biodiesel degrade twice as fast as diesel alone. A liquid fuel's flash point is the lowest temperature at which a flammable liquid will give off enough vapor to ignite briefly when exposed to a flame. Biodiesel has a flash point of 266°F (130°C) where conventional diesel has a flash point of 125°F (52°C). Biodiesel and biodiesel blends are therefore safer to handle, store, and use than conventional diesel.

The National Fire Protection Agency (NFPA) has a standard hazard placard to identify biodiesel at stationary facilities. The NFPA 704 hazard placard used for B100 biodiesel is shown in **Figure 4**. The "1" shown in the red area indicates that the fuel must be preheated before ignition can occur. In other words, the biodiesel becomes unstable if heated above 200°F (93°C). The "0" shown in the blue indicates that biodiesel poses no health hazard, and the "0" shown in the yellow area indicates that biodiesel poses no reactivity hazards.

Biodiesel Safety Summary

- *Environmentally safe*
- *Nontoxic and biodegradable*
- *Higher flash point than conventional diesel*
- *NFPA rated minimal fire hazard*
- *Spontaneous combustion risk*

Notes

Figure 4: *NFPA 704 hazard placard for B100 biodiesel. Source: NFPA.*

Figure 5: *Hazardous material description identifies number UN 1993 placard for diesel. Source: DOT, PHMSA.*

Placards and/or other markings are required on bulk shipments to aid emergency responders in the event of an emergency. The U.S. Department of Transportation (DOT) identifies diesel in transport with the hazardous material description number of UN 1993 (see **Figure 5**). No placards or warning signs are required for the transport of pure biodiesel (B100).

Biodiesel, as with many flammable liquids, poses a risk for spontaneous combustion on rags, paper, and other materials that retain heat while letting oxygen permeate. If the conditions are right, oily rags, clothes, even sawdust, can burst into flames with no apparent source of ignition. In December 2010, a biodiesel plant in New Oxford, Pennsylvania, was destroyed by spontaneous combustion inside the building (see **Figure 6**).

Fleet managers should be cautious in handling biodiesel-soaked rags in and around their maintenance and storage shops. Specific care should be taken to dispose of rags soaked in biodiesel. The following is a brief list of preventive measures when dealing with oily rags that can potentially cause spontaneous combustion:

- Do **NOT** machine dry rags because it can bring material to auto-ignition temperature.
- Do **NOT** pile up rags in a warm spot or direct sunlight.
- Air dry rags.
- Put rags in a bucket of water.
- Dispose of rags in airtight metal containers.

Biodiesel is generally safer than conventional diesel. It produces fewer emissions, it is less harmful to human health, vapors are less combustible, and precautions taken with diesel are easily applied to biodiesel.

Figure 6: *Possible biodiesel fire. Source: NAFTC.*

Summary

This material develops the understanding of biodiesel as an alternative fueling option for fleet managers and explains how to green fleets with biodiesel and incentives to implement its use. Additional analysis describes the cost, advantages, and performance of biodiesel. Most diesel fleets can utilize biodiesel in various blends with only minor vehicle modifications. A major obstacle when implementing it as a fleet fuel is the required changing of fuel filters after its initial use. Biodiesel can be used with little changes to infrastructure and fueling equipment. Mandates are currently increasing biofuels production. A major benefit is that it is a domestically produced resource that offers the potential for fleet managers to use U.S. fuel while decreasing the emissions of their fleet.

Test Your Knowledge

1) **True or False:** The cost of biodiesel depends on the biodiesel blend. For example, B20 costs less than B100.

2) Biodiesel is produced from feedstocks such as soybean oil and vegetable oil. New research also suggests _____ can be made into biodiesel.

3) **True or False:** The biggest obstacle for widespread biodiesel use in fleets is lack of infrastructure.

4) List one of the three reasons mentioned in the text as to why the U.S. should use biodiesel.

5) **True or False:** Fleet managers should expect to change fuel filters after the first tank of biodiesel runs through their vehicle.

Answers: 1) True; 2) Algae; 3) False — availability of biodiesel is the biggest obstacle; 4) Reduces operating costs; reduces GHG emissions; and improves corporate image; 5) True.

Resources

National Clean Diesel Campaign (NCDC)

Learn More About NCDC:
http://www.epa.gov/cleandiesel

EPA's National Clean Diesel Campaign (NCDC) promotes clean air strategies by working with fleet managers to reduce diesel emissions. Recent diesel rulemakings have focused on light- and heavy-duty highway vehicles, nonroad diesel equipment, locomotive and marine engines, and large ocean-going vessels. This program offers incentives to reduce emissions from older diesel engines, grant funding for emission reducing technology implementation, and information on impacts of diesel emissions.

- **A C & S Incorporated** (http://acandsinc.com/) – Includes information about the growing need for biofuels and the efforts taken to produce biodiesel.
- **All Things Biodiesel** (http://allthingsbiodiesel.com/) – Online marketplace for biodiesel information, networking, and the industry's online retail store.
- **Alternative Fuels Data Center – Biodiesel** (http://www.afdc.energy.gov/afdc/fuels/biodiesel.html) – Offers publications about the use of biodiesel, a station locator, biodiesel basics, and other helpful information about the fuel.
- **Bio Trucker** (http://biotrucker.com/) – Presents information on a network of biodiesel fueling sites accessible to American truck drivers.
- **Biodiesel – America's Advanced Biofuel** (http://biodiesel.org/) – Provides information about producing and utilizing biodiesel.
- **Biodiesel Education Network** (http://askben.info/) – Allows users to ask questions related to biodiesel use, implementation, and utilization.
- **Biodiesel Industry Guide** (http://thebiodieselindustryguide.com/) – Provides an extensive list of organizational contacts within the biodiesel industry.
- **Biodiesel Now** (http://www.biodieselnow.com/) – Includes forums, links, and mailing lists concerning biodiesel use in different world markets.
- **Clean Cities 2012 Vehicle Buyer's Guide** (http://www.afdc.energy.gov/afdc/pdfs/51785.pdf) – Offers model-specific information about vehicles that utilize alternative fuels.
- **Diesel Technology** Forum (http://www.dieselforum.org/) – Provides education to the public about environmental and energy progress through diesel technologies.
- **Drive Biodiesel** (http://www.drivebiodiesel.net/) – Shows users a comprehensive list of fueling stations that offer biodiesel in each state.
- **Fuel Economy** (http://fueleconomy.gov) – Official U.S. government source for information pertaining to the fuel economy ratings and fuel efficiency.
- **Green Car Congress – Biodiesel** (http://www.greencarcongress.com/biodiesel/) – Presents up-to-date articles concerning the biodiesel industry.
- **National Biodiesel Accreditation Program** (http://bq-9000.org/) – Offers information on biodiesel production, quality assurance, and supplier regulation compliance.

- **National Biodiesel Board** (http://www.nbb.org/) – Displays data concerning biodiesel-related legislation and information about utilizing biodiesel.
- **National Biodiesel Foundation** (http://biodieselfoundation.org/) – Supports and promotes outreach, education, science, and demonstration activities related to the advancement of biodiesel.
- **Sustainable Biodiesel Alliance (**http://sustainablebiodieselalliance.com/dev/) – Includes news and information about the sustainable biodiesel market.
- **U.S. Department of Energy – Biomass Program** (http://www1.eere.energy.gov/biomass/) – Includes information about using biomass to produce alternative fuels.
- **U.S. Department of Energy – Clean Cities Program** (http://www1.eere.energy.gov/cleancities/) – Addresses the nation's energy security by supporting local actions and groups to reduce overall petroleum consumption in transportation.
- **U.S. Department of Energy (DOE)** (http://energy.gov/) – Agency that helps ensure America's security and prosperity by addressing energy related problems with emerging technologies.
- **U.S. Department of Energy (DOE) Vehicle Technologies Program** (http://www1.eere.energy.gov/vehiclesandfuels/) – Develops more efficient transportation technologies that help reduce domestic dependence on foreign petroleum.
- **U.S. Environmental Protection Agency (EPA)** (http://www.epa.gov/) – Agency that acts to protect public health and the environment by writing and enforcing pertinent legislation.

Footnotes

1 Environmental Defense Fund, "Greening Fleets, A Roadmap to Lower Cost | and Cleaner Corporate Fleets," http://business.edf.org/sites/business.edf.org/files/greening-fleets.pdf.

2 U.S. Department of Energy, Alternative Fuels Data Center, State Incentives and Laws, www.afdc.energy.gov/afdc/laws/state, (updated June 15, 2011).

3 Berkeley BioDiesel, History of Biodiesel Fuel, http://www.berkeleybiodiesel.org/history-biodiesel-fuel-traced.html.

4 U.S. Department of Energy, Alternative Fuels Data Center, Alternative Fuels Price Reports, http://www.afdc.energy.gov/afdc/price_report.html.

5 U.S. Department of Energy, Energy Efficiency and Renewable Energy, Biodiesel Compared to Petroleum Diesel, http://www.fueleconomy.gov/feg/biodiesel.shtml (updated Jan. 18, 2012).

6 National Biodiesel Board, Performance Fact Sheet, http://www.biodiesel.org/docs/ffs-basics/performance-fact-sheet.pdf?sfvrsn=4.

7 National Biodiesel Board, Cold Flow Backgrounder, http://www.biodiesel.org/docs/ffs-performace_usage/cold-flow-backgrounder.pdf?sfvrsn=4.

Notes

CASE STUDY

Location: Morgantown, WV

Company: Monongalia County Schools' Transportation Department

Study: Biodiesel

In West Virginia, Monongalia County Schools' Transportation Department started using biodiesel in its school bus fleet beginning in 2003. The school system's experience in adopting biodiesel included the benefits of reduced emissions, lower fuel costs, and budget savings. The challenges, however, also involved pumping fuel tanks that were improperly blended and achieving driver buy-in during the transition.

Shortly after state legislation created incentives for counties and municipalities to use alternative fuels, officials committed to the use of B20 biodiesel in fueling the school bus fleet. The fleet's experience with biodiesel was one of the first in the state, and Irv Schuetzner, the school system's transportation director, said their use of biodiesel has been successful in multiple ways.

Decision Points

As fleet managers decide to use alternative fuels, these decisions are often driven by economic incentives, government mandates, and/or the benefits of green branding and emissions reductions. All these factors played a role in influencing the Monongalia County Board of Education.

As mentioned, members of the Monongalia County Board of Education encouraged the use of biodiesel after the West Virginia State Legislature created budget incentives for local governments. The school board qualified for these incentives, starting the momentum toward adopting alternative fuels in the school bus fleet.

After state incentives were put in place, Schuetzner explained that Monongalia County was the first school bus fleet in West Virginia to implement the use of biodiesel. Two counties were early adopters of alternative fuels in West Virginia — Monongalia County adopted biodiesel, and Wood County adopted natural gas. Biodiesel provided Monongalia County immediate returns because it did not have to invest in new buses, conversions, or fueling infrastructure.

Using biodiesel affected the district's image in a positive way. Schuetzner explained how students, parents, and drivers could notice an immediate difference in the amount of black smoke coming from the exhaust. Particulate matter in the exhaust was noticeably reduced, and the Transportation Department went further by implementing "No Idle Zones" around schools. The no idle zones have not only reduced emissions, but also have helped save fuel.

Fleet Facts

Describing the size of the bus fleet, along with the miles driven, amount of fuel consumed, and vehicle specifications will help better characterize the significance of changing from conventional fuels to an alternative fuel. Monongalia County Schools transports approximately 9,200 students per day with 105 buses. Each bus travels an average of 120 miles per day, accounting for roughly 1.5 million miles annually. Based on this mileage, the school system uses between 200,000 and 250,000 gallons of fuel per year.

QUICK FACTS

Fuel Type: B20 Biodiesel

Number of Buses: 105

Miles Driven Annually: 1.5 Million

Estimated Fuel Consumption: 220,000 gallons

The school bus fleet is made up of Blue Bird buses that have diesel engines built by Cummins, Caterpillar, or International. The newer model buses have Cummins and Caterpillar engines, while the majority of older buses have the International engine. Schuetzner explained that warranties on these engines range between two and five years; however, he anticipates the overall life cycle for most buses to be at least ten years. According to Schuetzner, the manufacturers have become more overt in their warranty of biodiesel as using the fuel becomes more widespread.

The engines mentioned above are typically between 225 and 245 horsepower, with the total gross weight of the bus averaging 33,000 pounds. The estimated miles per gallon for the Blue Bird buses is around 7 MPG depending on the terrain. The fuel tanks on the buses hold either 80 or 100 gallons, with fueling taking place every three to four days for the 80-gallon tanks and every four to five days for the 100-gallon tanks. In the average ten-year life cycle, most of the buses register 200,000-300,000 miles of travel. Schuetzner explained the purchase price of a new bus is around $83,000-90,000 and that he can sell retired buses for around $3,000-6,000.

Fuel Supply and Infrastructure

Monongalia County Schools purchases its fuel from Bruceton Petroleum, a local vender. Bruceton Petroleum delivers 7,500 gallons of biodiesel every ten days to the Transportation Department's bus depot. The private fuel supplier is eligible for available federal tax credits on the production and distribution of alternative fuels. The school system enjoys affordable prices as the supplier passes along the savings. Schuetzner indicated that the wholesale purchase of biodiesel ended up being less expensive than conventional diesel — regularly 9% cheaper.

Winter weather in West Virginia can be frigid, and using biodiesel in this area requires employing cold weather additives to prevent clouding and gelling of the fuel. Bruceton Petroleum blends the additive in the tanker during shipment. Schuetzner described an early experience

Photos courtesy of Monongalia County Schools.

during which the driver from Bruceton Petroleum was unfamiliar with the blending process and provided the bus depot with an incorrect blend. The supplier quickly rectified the situation by pumping out the tanks and providing the correct blend of B20 biodiesel.

The school system's bus depot uses an above ground fuel storage tank, and when Monongalia County Schools started using biodiesel, it required quarterly chemical tests. The tests were necessary to check the fuel's flash point and to determine if there were unacceptable amounts of bacteria and algae in the fuel. Since 2003, they have only needed to clean the tanks one time, and chemical testing has been reduced to semi-annually.

Costs

As mentioned previously, the per-gallon purchase price of biodiesel, according to Schuetzner, has been consistently cheaper than conventional diesel. These prices have been about 9% cheaper, due largely to the federal and state tax credits used by the fuel suppliers. This fuel price includes the additives needed to prevent clouding and gelling. Overall, fuel accounts for 5-10% of Schuetzner's operating budget, and these fuel savings can add up to tens of thousands of dollars.

From a financial perspective, state initiatives also led to increases in local agency operating budgets for those using alternative fuels. For Schuetzner's department, this amounted to roughly $150,000 per year in increased budget allocations. This increased budget allocation could help offset any cost premiums necessary in converting to alternative fuels. Interestingly, for Monongalia County Schools, biodiesel was cheaper to operate than conventional diesel, and there were no initial investments required for conversions, new vehicle purchases, or the installation of specialized fueling infrastructure. Biodiesel, as opposed to other types of alternative fuels, does not require any specialized infrastructure and the only initial cost premiums were the extra fuel filters needed during the initial switch.

Maintenance and Satisfaction

When Monongalia County Schools first adopted biodiesel as its primary fuel source, the transportation department planned for the replacement of fuel filters on all the buses — a necessary measure because of biodiesel's cleansing effect on the engine. This was a nominal expense on the front end of the implementation process, and this step prevented complications with other onboard fuel systems.

Photos courtesy of Monongalia County Schools.

Preventive maintenance is performed on each of the buses every 6,000-10,000 miles. The regularly performed, scheduled maintenance replaces fluids and filters and provides state inspections on all buses. All mechanics working at the bus depot attended state-sponsored training on the use and applications of biodiesel, including the cleansing and lubricity properties of the fuel.

Initially, bus drivers were apprehensive about using biodiesel; however, they quickly realized biodiesel provided the same power and performance to which they were accustomed. Drivers experienced no loss of engine power, and the overall feedback of using biodiesel has been excellent.

Overall feedback has been positive, and the local community – from parents to administrators – have embraced the cleaner air that biodiesel provides. People can notice a reduction in black soot coming from the exhaust of these buses, and when 20 buses are lined up in front of a school, the reduced emissions can have a significant impact on children's health.

Summary

Monongalia County Schools was one of the first in West Virginia to adopt an alternative fuel in the operation of its school bus fleet. With more than 1.5 million miles driven annually, the change in fuel type would prove to have significant effects on emissions and fuel costs. Schuetzner also confirmed that biodiesel has helped reduce unscheduled maintenance through its lubricity properties and is safer due to its higher flash point. By educating maintenance personnel and garnering driver buy-in, the transition from conventional diesel to biodiesel has been a popular and successful achievement.

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