

What Is Biodiesel?

Biodiesel is a nontoxic, biodegradable replacement for petroleum diesel. Biodiesel is made from vegetable oil, recycled cooking oil and tallow. Chemically biodiesel is described as a mono alkyl ester. Through a process called esterification, oils and fats are reacted with methanol and a sodium hydroxide catalyst to produce fatty acids along with the co-products: glycerin, glycerin bottoms, soluble potash and soaps. Biodiesel belongs to a family of fatty acids called methyl esters which are defined by the medium length, C16-18 fatty acid linked chains. These linked chains help differentiate biodiesel from regular petroleum diesel.

Although biodiesel contains a similar number of BTUs as petroleum diesel (118,000 vs. 130,500 BTUs per equivalent translating to similar engine performance in torque and horsepower), the chains are oxygenated and have a higher flash point. This makes biodiesel a much cleaner burning fuel while being safer to handle and store than petroleum diesel. In tests conducted at the Colorado Institute for Fuels and High Altitude Engine Research, a 20% blend was found to reduce particulate discharge by 14%, total hydrocarbons by 13%, and carbon monoxide by more than 7%.

Biodiesel (including a B20 blend) is now recognized by both the Environmental Protection Agency and Department of Energy as an alternative fuel, and it qualifies for mandated programs under the Clean Air Act Amendments (CAAA 90) and the Environmental Protection Act of 1992 (EPACT). In addition, biodiesel is:

- non-toxic (its toxicity is less than 10% of that for ordinary table salt)
- biodegradable (degrades in about the same time as sugar)
- essentially free of sulfur and carcinogenic benzene
- derived from renewable, recycled resources, which don't add significantly to the greenhouse gas accumulation associated with petroleum-derived fuels.

Direct benefits associated with the use of biodiesel in a 20% blend with petroleum diesel as opposed to using "straight" petroleum diesel include:

- increasing the fuel's cetane and lubricity for improved engine life
- reducing substantially the emissions profile including CO, CO₂, SO₂ particulate matter (PM) and volatile organic compounds (VOCs)
- helping to clean injectors, fuel pumps and fuel lines.

These benefits occur while requiring virtually no engine modifications or costly infrastructural additions. In fact, with the addition of a catalytic converter, nitrous oxides (NOX) can be reduced as well, allowing B20 fleets the flexibility to meet various air quality compliance criteria.

Ultimately, biodiesel provides the diesel fleet operators and vehicle/equipment owners (including both on and off-road use, stationary generation, and marine environments) the opportunity to comply seamlessly with federal Clean Air and EPACT mandates without the burden of many of the high costs in capitalization associated with other alternative fuels. A number of independent studies have been conducted comparing the various alternative fuels, including studies conducted by the US Department of Agriculture and

the US Department of Energy's National Renewable Energy Lab. In these, the life cycle costs and the projected cost per mile traveled were compared and biodiesel was substantially the most cost competitive of the alternative fuels.

How Do I Get Biodiesel?



Biodiesel is available now for delivery anywhere in the U.S. and abroad. Biodiesel can be shipped in one to five gallon containers, 55 gallon drums, 275 & 330 palletized totes, and in bulk by truck and rail tanks. Delivery can be made directly to your central fueling site, or through your existing petroleum distributor. Biodiesel Industries works with each customer to establish the most convenient method of incorporating the use of biodiesel into their operation. Demonstrations and trial programs are available so you can see just how easy it is to start using biodiesel

Why Should I Consider Using Biodiesel?

Practically speaking, the use of biodiesel should make a lot of sense to the diesel operator, owner and fleet manager. It can be splash blended into a B20 blend making it virtually seamless, B20 qualifies for compliance with a number of federal and state mandates, and it requires virtually no different handling considerations than regular petroleum diesel. At a 20% blend it will substantially help reduce most emissions, including the offensive engine exhaust and irritating nature of the fumes and smell associated with petroleum diesel. At a 20% blend it will also help increase the life of the engine because of the higher levels of lubricity and cetane.

Biodiesel is safe to handle and is biodegradable. In fact, in California it is registered for use in remediation following oil spills. Biodiesel requires virtually no engine modifications or engine replacements while still allowing the existing diesel engine to meet many mandated programs. This gives the diesel operator, owner or fleet manager the option to reduce the need for new or more expensively priced alternative fueled vehicles, costly modifications, engine modifications, or of having to re-train service personnel. In addition, the use of B20 requires few changes or modifications to existing fueling centers, repair facilities, or distribution systems.

From an altruistic perspective, wide-scale implementation of biodiesel would resolve a number of issues. First, the use of biodiesel blended fuels would help the diesel operator/owner meet any civic obligations in helping reduce the environmental impact of

the use of the diesel engine, short of replacing it with a less efficient or more costly option. Second, the use of biodiesel would help insure greater strategic national security by displacing an equivalent amount of foreign crude oil. Given that 35 billion gallons of diesel are used each year in the U.S. and that more than 50% of this figure is imported, the use of diesel contributes to both the U.S. trade imbalance and a national security concern relative to dependency on foreign oil. There is no doubt that the diesel engine represents the stalwart foundation for U.S. commerce and industry. The capitalization and infrastructure associated with diesel amounts to hundreds of billions of dollars, and it is safe to say that diesel will remain the fuel of choice for some time to come. However, biodiesel's contribution could be substantial and well timed in providing an option which will help meet the environmental and strategic concerns of the U.S., while allowing the financial realities of infrastructural investments in diesel technology to be compensated. Not only would its use help substantially reduce the environmental impact and decrease the US dependency on foreign crude, but it would also have positive impacts by helping curb localized waste streams, bringing new economic development into communities involved with biodiesel, and expanding agricultural uses for feed stock sourcing. Ultimately, everyone could win.

How Does Biodiesel Compare to Petroleum Diesel?

Biodiesel has physical and chemical properties similar to petroleum diesel, which allows it to be readily splash blended and used in conjunction with petroleum diesel. Biodiesel contains a similar number of BTUs (118,000 vs. 130,500 BTUs per equivalent translating to similar engine performance in torque and horsepower), but the fatty acid chains that comprise biodiesel are oxygenated and have a higher flash point than petroleum diesel. In addition, biodiesel contains virtually no sulfur or carcinogenic benzene. Overall, these factors make biodiesel a much cleaner burning fuel while being safer to handle and store than petroleum diesel. In tests conducted at the Colorado Institute for Fuels and High Altitude Engine Research, a 20% blend (B20) was found to reduce particulate discharge by 14%, total hydrocarbons by 13%, carbon monoxide by more than 7%, and sulfur dioxide by 20%.

Emission Benefits

Biodiesel reduces particulate matter, carbon monoxide, total hydrocarbon, and sulfur dioxide emissions. With the use of a catalytic converter, nitrous oxide emissions can be reduced as well.

Engine Power

The energy release of biodiesel is about the same as for petroleum diesel (118,000 vs. 130,500 BTUs). Therefore, engine torque and horsepower remain virtually the same.

Conversion and Engine Adjustments

None required. A changeover to B20 does not require any engine conversion or adjustments. Due to the solvent characteristics of biodiesel, a fuel filter change will most likely be required after the first few hours of operation due to the cleaning effects of biodiesel to the fuel tank, lines and injectors.

Fuel Consumption

Similar to petroleum diesel.

Cetane

Higher than petroleum diesel (53 vs. 42 for #2 diesel fuel), which will help reduce engine knocking and contribute to a smoother running engine.

Lubricity

Biodiesel has a much higher lubricity level than petroleum diesel and compensates for the loss of lubrication with the new low-sulfur and CARB petroleum diesel fuels.

Winter Conditions

Biodiesel Industries has developed a proprietary formulation for treating biodiesel to operate trouble-free in severe winter conditions.

Safety in Handling and Storage

Biodiesel is as safe or safer than petroleum diesel to handle or store. Biodiesel does not produce dangerous vapors at normal ambient temperatures, and can it be stored in the same containers and tanks as petroleum diesel.

Environmental

Biodiesel is safer for the environment than petroleum diesel. It is less toxic than ordinary table salt (one-tenth the level of toxicity per unit weight) and is as biodegradable as dextrose (sugar). The use of biodiesel does not contribute significantly to the amount of new greenhouse gases, since any carbon released is already in the carbon cycle, versus petroleum diesel which contributes millions of tons of new carbon annually derived from the lithosphere (earth).

Sourcing

The US currently produces an estimated surplus of 2 billion gallons of oils and tallows that would be available for biodiesel production.

Energy Security

Biodiesel is produced from renewable domestic resources and could supplement part of the US's dependency on foreign petroleum production. This could displace a proportionate amount of importation while securing new sourcing to support domestic industrial and commercial infrastructures dependent on diesel fuels.

What Is Biodiesel Industries?

Biodiesel Industries is a U.S. corporation committed to advancing the technology and principles needed to establish biodiesel as a practical and affordable alternative fuel. Its long-term strategies include:

- developing new and/or more efficient processing technologies and techniques
- insuring the highest quality and standards for its biodiesel
- expanding the placement of its biodiesel production facilities both domestically and globally
- taking advantage of feed stock sourcing, economic development opportunities, and established diesel demand
- substantially reducing the price of biodiesel
- implementing coordinated lobbying and industry efforts to increase biodiesel feasibility and demand
- securing new and more affordable feed stock sourcing
- establishing biodiesel as a viable commercial endeavor and Biodiesel Industries as a leader in the biodiesel community

Interested parties with established funding mechanisms for industrial development and/or environmental projects are encouraged to contact Biodiesel Industries.

Cold Weather Handling and Blending

Like petroleum diesel fuel, biodiesel and B20 will gel at below freezing temperatures. As with #2 diesel, blending biodiesel with #1 diesel or kerosene in cold weather conditions will help alleviate the problem by substantially lowering the cloud and pour points of the blend. The cold weather characteristics of a biodiesel blend will be affected by any cold weather additives that were present in the petroleum diesel prior to the blend, or added thereafter.

Cold Weather Storage and Transportation

Neat biodiesel (100%) should be transported and stored at temperatures above 50 degrees F to guard against potential gelling prior to blending with petroleum diesel.

Anti-gel Blends

Blends of biodiesel and either #1 diesel or kerosene exhibit excellent anti-gel characteristics. Such blends remain effective at temperatures well below those at which #2 diesel fuel gels, down to approximately -20 degrees F. Therefore, the use of such blends in winter conditions is recommended.

Blending at Low Temperatures

Blending of biodiesel should be undertaken at fuel temperatures above 40 degrees F. At lower temperatures, chilled petroleum diesel fuel may cause a haze or solids to form during the blending process.

Splash Blending

In cold weather, the preferred method when splash blending is to add biodiesel atop petroleum diesel, since the specific gravity of biodiesel is slightly higher. Once mixed, biodiesel and petroleum diesel will remain blended.

At higher fuel and ambient temperatures, the recommended method is to add the larger-volume blend component atop the smaller-volume blend component (e.g., for a 20% biodiesel blend, add the petroleum diesel atop the biodiesel). This takes advantage of the greater agitation caused by entry of the larger-volume blend component.

Cloud and Pour Points

The cloud and pour point temperatures of a biodiesel blend will be higher than those of the petroleum diesel used in the B20 blend. Although anti-gel agents can be used to reduce these temperatures, if the blend is allowed to cool below its cloud point, crystalline solids that may appear will require the blend to be warmed to a temperature above the cloud point, and reliquification may be expedited with stirring or agitation.

Biodiesel Handling, Transport, & Storage

Biodiesel has a much higher flash point than petroleum diesel (approximately 200 degrees Fahrenheit higher). As a result, it presents a much lower potential for explosion than petroleum diesel. Biodiesel is as biodegradable as dextrose sugar and has one-tenth the toxicity of ordinary table salt per unit weight. In general, the procedures employed for transport, storage and handling of petroleum diesel are more than adequate for biodiesel.

Transportation

Under US Department of Transportation hazardous material determination, in the Code of Federal Regulations 49 CFR 171-173, the transportation of "neat" Biodiesel may be handled in the same manner as vegetable oil. In a blend, B20 (20% blend of biodiesel with petroleum diesel) should be handled in the same manner as petroleum diesel.

Both neat and B20 blends must be shipped in clean, dry containers or tanks, free of contaminants, dirt or moisture, which can promote the degradation of the fuel.

Storage Environment

Like petroleum diesel, biodiesel should be stored in a clean, dry, dark environment. Extremes of temperature should be avoided when possible, since biodiesel has a higher cloud point and pour point than petroleum diesel (see "Cold Weather Handling and Blending"). Acceptable materials for biodiesel storage include black mild steel, stainless steel, fluorinated polyethylene, and fluorinated polypropylene. Concrete and concrete lined tanks should be avoided since biodiesel tends to degrade concrete over time.

Above Ground Storage

The requirements for above ground storage of B20 will be the same as for petroleum diesel. In the case of "neat" (100%) biodiesel, it may be treated the same as for the storage of vegetable oil, and the biodiesel user should check with appropriate agencies to determine whether any special state or local regulations are needed or pertain to such storage.

Underground Storage

The requirements for underground storage of either neat or B20 are regulated in accord with EPA standards, and are the same as for petroleum diesel. Information concerning these regulations can be found in the Code of Federal Regulations 40 CFR 280.

Handling

Although biodiesel is non-toxic, biodegradable and much less irritating to the skin than petroleum diesel, it is recommended that the standard handling procedures used for petroleum diesel be applied to biodiesel and biodiesel blends. These procedures should include the wearing of appropriate eye protection and the provision of adequate ventilation.

Biodiesel in the Marine Environment

Biodiesel is a perfect replacement for petroleum diesel fuel in marine applications. Not only does it keep the marine environment cleaner, but it helps make boating more enjoyable by reducing the black smoke and foul smell associated with petroleum diesel exhaust. Because Biodiesel is oxygenated, it promotes cleaner combustion. As a result, Biodiesel exhaust fumes are friendlier to operators, crews, and passengers, often being described as smelling like french fries.

The strong cleaning action, increased lubricity and higher levels of cetane make the use of Biodiesel highly advantageous in the marine environment. Biodiesel's solvent

characteristics help keep injectors, injection pumps, fuel lines, fuel tanks, and internal parts such as rings, pistons, and valves free of damaging deposits. This cleaning action will require that fuel filters be changed after the first few hours of operation following the Biodiesel's introduction, but its continued use will help keep the engine clean and free of accumulated deposits. Biodiesel's high lubricity effectively compensates for the lack of fuel-related lubrication in the new low-sulfur and CARB petroleum diesel fuels. Moreover, the higher levels of cetane will help reduce engine knocking and provide for smoother engine performance.

Biodiesel is kinder to the marine ecology than petroleum diesel. Neat Biodiesel (100%) is non-toxic and biodegradable (similar to dextrose sugar). It also is free of sulfur and carcinogenic benzenes. The chemical structure of Biodiesel enables it to more readily biodegrade in an aqueous environment without causing toxic damage. Just as significant, when blended with petroleum diesel, Biodiesel can increase the biodegradability of the petroleum diesel by as much as 500%. The ever-present danger of accidental fuel spills makes this especially important in ecologically sensitive and protected waterways. In fact, in California, Biodiesel has been approved in helping with remediation of petroleum oil spills.

Biodiesel Is Cost Competitive

Biodiesel Beats Other Alternative Fuels on Cost

A number of independent studies have been conducted comparing the various alternative fuels. Included in this list were studies conducted by the US Department of Agriculture and the US Department of Energy's National Renewable Energy Lab. In these, the life cycle costs and the projected cost per mile traveled were compared, and biodiesel was substantially the most cost competitive of the alternative fuels.

In the Department of Agriculture study, considerations were given to the total cost for an urban transit operation, including the costs for building new refueling infrastructure that are associated with alternative fuels other than biodiesel. The economic model indicated that biodiesel blends could be utilized at as little as 3.2 cents more per mile driven than petroleum diesel - an amount easily offset by other savings. The additional cost for compressed natural gas was as much as 42 cents per mile driven, and the additional cost for methanol was 73 cents.

Unlike other alternative fuels, biodiesel can be used in existing conventional diesel engines without making costly modifications or replacements.

- Biodiesel makes it possible to meet increasingly stringent anti-pollution standards without incurring the high costs of buying new vehicles and special spare parts, or having to specially train mechanics and maintenance personnel.
- Biodiesel has virtually the same energy content as petroleum diesel, so engine performance and fuel mileage are essentially the same as for petroleum diesel.
- Biodiesel is easily splash blended with petroleum diesel to improve emission profiles and fuel characteristics (i.e. lubricity, cetane, and cleaning qualities) at an overall cost that is lower than for other alternative fuels.

- Biodiesel can be transported, handled and stored at low pressure and ambient temperatures in similar ways as petroleum diesel. In a B20 blend it can be distributed as easily as petroleum biodiesel and does not require special fueling stations or other costly infrastructural additions.
- Biodiesel does not require costly engine modifications or retrofits.
- Biodiesel does not require costly special transportation or fueling stations.
- Biodiesel produces similar engine performance characteristics and fuel mileage as petroleum diesel.
- Biodiesel qualifies as an alternative fuel for AFV credits under EPACT.

Biodiesel is Proven

Biodiesel has successfully powered vehicles over millions of miles in the US and around the world.

Biodiesel in as low as a 20% blend (B20) meets Federal requirements for EPACT credits and qualifies diesel engines as alternative fueled vehicles using as little as 450 gallons of Biodiesel annually.

Biodiesel is used extensively in Europe. In France, by law, all transportation diesel fuel reportedly contains at least a 5% blend of Biodiesel. In Austria and Germany, Biodiesel is reportedly found at the pump, side by side with petroleum diesel, and it is gaining approval and usage in numerous other European countries. Not only does Biodiesel reduce vehicle-related pollution, but it also decreases dependence on imported petroleum supplies while helping support domestic agriculture.

More than 80 mass transit authorities have participated in successful Biodiesel demonstration programs in the US. The programs have shown that Biodiesel reduces EPA-targeted emissions, while maintaining the same fuel mileage, engine performance and longevity as conventional petroleum diesel fuel.

Biodiesel has been tested by research organizations including the Southwest Research Institute and Ortech International, and it has been proven effective in reducing EPA-targeted emissions, while maintaining engine performance and helping to increase longevity.

Biodiesel has been used in demonstration programs by a number of state and federal agencies, including numerous states' Department of Transportation, the US Postal Service, National Parks, Transit Districts, Sanitation Fleets and the US Army.

Studies Show Biodiesel Makes Economic Sense

Recent studies by Booz-Allen & Hamilton, Inc. and the University of Georgia have found that buses and other fleets fueled with B20 can operate cost competitively with vehicles using other alternative fuels. When considering the seamless integration, convenience, safety and relatively low cost, using Biodiesel to help meet EPA-targeted emissions and EPACT requirements is economical, affordable and makes good common sense.

Biodiesel: Cost Effective Lubricity Enhancer

All diesel engine fuel injection equipment, irrespective of specific design, depends on the fuel pumped for lubrication of internal moving parts. Failures due to a lack of lubricity in the fuel are caused by either the low-pressure (upstream) side of the fuel injection equipment, or the high-pressure (downside) side. Potential problems on the low-pressure side include failures in governing, advance and pump drive, and on the high-pressure side in sub-spec output.

In recent years, federal and state regulations have targeted the reduction of sulfur and aromatics in diesel fuel in order to obtain cleaner air quality. Unfortunately, the processes that remove sulfur and aromatics also remove components (polyaromatics and nitrogen compounds) that help provide the fuel with its lubricating properties (lubricity). As a result, the new low-sulfur and CARB (California Air Resources Board) petroleum diesel fuels tend to lack sufficient lubricity. However, these fuels blended with as little as 0.4% Biodiesel can meet or exceed the minimum lubricity required by the US military and a proposed new ASTM standard for petroleum diesel fuel. That's right, with a less than 0.5% mix of Biodiesel, a low-sulfur or CARB fuel can become a premium diesel blend, relative to lubricity.

Biodiesel is proven to have a much higher level of lubricity than the new low-sulfur petroleum diesel fuels. When blended at even relatively low percentages with petroleum diesel, Biodiesel can completely offset the lack of lubricity in the low-sulfur and CARB diesel fuels, while at the same time help reduce EPA-targeted exhaust emissions when used in higher percentages.

The high lubricating properties of Biodiesel can help protect delicate fuel injection equipment cost-effectively. As previously mentioned, even at low blends (i.e. 0.4%), Biodiesel improves lubricity, with the maximum benefit occurring at blend levels of approximately 10%.

Tests Show:

Biodiesel Restores Lubricity to Low-Sulfur Petroleum Diesel

The International Standards Organization (ISO) established a working group of experts from major diesel engine and equipment manufacturers to examine diesel fuel lubricity and the means for said testing. The group adopted two methods for its testing of lubricity: the BOCLE (Ball-on-Cylinder Lubricity Evaluator) and the HFRR (High Frequency Reciprocating Rig). In its employment of the BOCLE test, the group used the ASTM-5001 test conditions and changed them by increasing the speed and load, while modifying the surface finish of the cylinder (now known as the Scuffing BOCLE test). Through the Scuffing BOCLE test, the group found that with as little as 0.4% Biodiesel blended with #1 petroleum diesel, the resulting blend provided more than the 3,300 gram minimum lubricity rating specified by the US military and by ASTM in its proposed new standard for premium diesel fuel.

Biodiesel: Biodegradable, Nontoxic, Renewable, & User Friendly

Biodiesel fuel and fuel additives are derived from organic, renewable feed stocks. They are readily biodegradable and less toxic than ordinary table salt. Moreover, because Biodiesel is oxygenated and has a much higher flash point than petroleum diesel, Biodiesel engine exhaust is "easier" on humans, smelling much better with much less sootiness, and it is safer for the environment as well.

The C16-18 methyl esters that comprise Biodiesel are considered readily biodegradable because of their chemical nature. This is confirmed by extensive studies done by several leading universities and test facilities. Test data reveals that experimentally determined oxygen demand and carbon dioxide production (calculated as a percent of theoretical values) for Biodiesel is more beneficial than for petroleum diesel fuels. Moreover, C16-18 methyl esters do not show any microbiological inhibition up to 10,000 mg/L. In a study performed by the University of Idaho, Biodiesel placed in water where microorganisms propagate biodegraded 95% in 28 days. During the same time period, petroleum diesel fuel degraded only 40%. In another study performed in an aquatic environment, Biodiesel was found to have similar biodegradable characteristics as dextrose (sugar).

The acute oral lethal dose for Biodiesel has been found to be at 17.4 g/Kg of body weight. In comparison, ordinary table salt is lethal at 1.75 g/Kg of body weight, making salt almost ten times more toxic than Biodiesel. This is to say that for an average male who might weigh 80 Kg (around 175 pounds), the lethal dose of salt would be 140 grams (about 4.5 ounces) and for Biodiesel about 1.4 Kg (or almost 3 pounds, which translates to almost 1.5 quarts of Biodiesel that would have to be ingested).

In twenty-four hour patch tests on humans, 100% Biodiesel produced only mild irritations, which in comparison was much less than that produced by a 4% aqueous soap solution.

Since Biodiesel is oxygenated and therefore promotes more complete combustion than ordinary petroleum diesel fuels, less particulate material and ensuing sooty smoke is produced. In addition, the smell of Biodiesel exhaust, even at a B20 blend (20% Biodiesel to 80% petroleum diesel), is far less offensive than petroleum diesel. Operators of equipment fueled with Biodiesel (including B20) compare the exhaust odor to the smell of french fries, and report the absence of the kind of eye irritation associated with petroleum diesel. In addition, the absence of carcinogenic benzenes in Biodiesel exhaust makes Biodiesel significantly safer.

With growing concerns focused on curbing the production of new greenhouse gases, Biodiesel once again has its place. Whereas petroleum diesel, like gasoline, coal and natural gas, come from within the earth (lithosphere), the carbon these fossil fuels release into the atmosphere contributes greatly to the observable increases in the amount of greenhouse gases (estimated in millions of tons annually). Biodiesel, on the other hand, is derived from plants and animal by-products with virtually all of the carbon contributed through the use of Biodiesel accounted for as already existing in the environment.

Therefore, Biodiesel does not contribute significantly to the growing perceived problem of greenhouse gases and their effect on our environment.

Alternative Fuel Comparison

Overview

The following comparison examines three different alternative fuels: Biodiesel, electric and compressed natural gas (CNG). In this comparison, both initial capital requirements and annual operating costs are examined. The methodology being employed should be very similar to that being used by a fleet manager who is considering his/her options relative to becoming compliant with EPACT and EPA mandates.

Assumptions

The fleet presently operates diesel-fueled vehicles. For purposes of convenience and comparison (since studies already exist) the vehicles are school buses and will travel an estimated 16,500 miles annually in a combination of city and highway environments that yield 7.5 miles/gallon.

Each CNG fast fuel station costs an estimated \$500,000, and it would not be uncommon for a fleet to require having several of these stations, depending on the size of the fleet and the miles traveled per vehicle. It is safe to assume that one way or the other, a fleet will have to pay for these stations as either a capitalized item or as an increase in the cost of the fuel. For purposes of this comparison, no additional costs are being passed on to the fleet operator.

No costs were attributed relative to the need for new maintenance facilities and/or the retraining of mechanics that would be needed for either CNG or electric, although one can assume that these costs would be relatively high in terms of both time and money. Also, no bias is being given to the limiting range associated with either CNG or electric, as opposed to being able to refuel the Biodiesel at virtually any gas station selling petroleum diesel, nor the need for new battery packs estimated at every two years. Capitalization rate on a new vehicle is 9% annually. The cost for a new CNG school bus is \$75,000, an electric bus is \$200,000, and a diesel/Biodiesel bus is \$50,000.

Biodiesel: Meeting Emission Standards Affordably

Operators of diesel-powered vehicles and equipment are facing increasingly stringent emissions-limiting regulations. Most alternative, lower-emissions fuels require either the purchase of special engines, or costly modification of existing ones. With Biodiesel meeting most emissions standards with no cost of conversion or modifications required. As a result, Biodiesel is a simple and affordable alternative for the owners or operators of diesel powered vehicles to consider. At a B20 blend it is the most affordable alternative

fuel.

Biodiesel is used in existing diesel engines to significantly improve the engines emissions profile, without: losing engine performance, undertaking costly engine modifications or replacements, or having to make expensive changes to fueling infrastructure. B20 reduces emissions in several EPA-targeted categories including: particulate matter, total hydrocarbons and carbon monoxide. With the inclusion of a catalytic converter, nitrous oxide compounds (NOX) can be reduced as well.

Tests conducted at the Colorado Institute for Fuels and High Altitude Engine Research found that a B20 blend was lower than 100% petroleum diesel in particulate discharge by approximately 14%, in total hydrocarbons by 13% and in carbon monoxide by over 7%. In an EPA Transient Cycle Emissions Test undertaken by Southwest Research Institute, a comparison was made between the emissions from #2 low-sulfur petroleum diesel fuel and a B20 blend using an oxidation catalyst. The test engine was a 1988 Detroit Diesel 6V-92 DDEC II. The results showed a reduction in particulate matter of approximately 45%, while hydrocarbons were reduced by 65% and carbon monoxide by 41%. Although sulfur emissions were not measured, a B20 blend will reduce sulfur by a corresponding 20%, since Biodiesel contains no sulfur, while #2 low-sulfur diesel contains 0.05% sulfur by weight.

Biodiesel and Engine Warranties

Manufacturer warranties cover defects in material and workmanship, and those warranties extend to engines burning Biodiesel. Those warranties do not cover engine problems related to any type of fuel including traditional petroleum diesel. Manufacturers state that fuel must meet certain criteria which may differ slightly by manufacturer, but all OEM's basically follow the standards set forth by the American Society for Testing and Materials ("ASTM"). The standard for diesel fuels is covered under ASTM D975, and for Biodiesel under ASTM PS 121. The ASTM standards define transportation fuel on 17 specific properties such as: specific gravity, sulfur content, cetane, and stability. Biodiesel blended at a 1:4 ratio with petroleum diesel (B20) has been analyzed by various labs around the country and falls within the parameters set by ASTM D975. As a result, Biodiesel Industries feels confident that the diesel engine operator should not be worried about the effect of a B20 blend on warranties. Biodiesel is produced to meet the strict quality control standards and specifications set forth in the industry standards established by the National Biodiesel Board. These were adopted following extensive testing and demonstrations, during which time, Biodiesel was shown to be a cleaner burning fuel and which helped to provide better lubricity than petroleum diesel fuel. That these merits could still be obtained in a B20 blend. Biodiesel qualifies not only an alternative fuel, but also as an enhancement to petroleum fuel

Biodiesel: Single Source Fuel for Multiple Compliance

- Least cost of alternative fuel options in meeting EPACT compliance for diesel powered vehicles.
- Cost effective since Biodiesel requires no engine modifications or replacements and utilizes existing diesel infrastructure. In addition, no retraining of diesel mechanics or redesign of maintenance facilities is needed.
- Recognized as an alternative fuel by the US Department of Energy, including at a 1:4 blend with petroleum diesel (B20), and registered with the US Environmental Protection Agency.
- Significantly reduces most EPA-targeted emissions.
- Has higher cetane levels than petroleum diesel for less engine knock and smoother running engines.
- Is oxygenated and has a higher flash point, making it a cleaner burning, safer fuel than petroleum diesel. The improved combustion helps eliminate exhaust particulates and makes for less sooty discharge and much less offensive exhaust odor.
- Has cleaning action which keeps engines free of power-robbing deposits.
- Has greater lubricity than petroleum diesel, which helps the engine compensate for loss of lubricity with the new low-sulfur and CARB diesel fuels, while improving injector pump life.
- Is non-toxic, renewable and biodegradable.
- Is produced from renewable and recyclable resources which can substantially help agriculture interests and/or help reduce urban waste streams.
- Has been shown to be safe and dependable with millions of trouble-free miles being logged using Biodiesel and Biodiesel blended fuels.
- Has been extensively used by public transit authorities, state Departments of Transportation, federal agencies (including the US Postal Service and National Oceanic and Atmospheric Administration), and private industry in the US, Canada and Europe.
- Helps secure domestic fuel supplies while helping reduce the US's dependency on foreign petroleum, improving the balance of trade deficit by keeping energy dollars in the US.
- Does not significantly contribute to the amount of new greenhouse gases, since the carbon released is already in the ecosystem, as opposed to fossil fuels which are being extracted from the lithosphere (earth) and released into the atmosphere.
- Makes good practical sense in meeting the demands for a cleaner environment and more secure country, and in meeting the future challenges associated with depleting energy reserves and balance of payment realities.

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