



Biofuel is the generic term for any liquid fuel that is not produced from fossil sources like oil, coal and gas. The most common biofuels are bioethanol and biodiesel, which are generally used to substitute for, or add to, petrol and diesel. Using biofuels helps reduce harmful CO₂ emissions which contribute to climate change.



Source: Degussa AG

History of biofuels

While biofuels have been in use worldwide for over 20 years now, their history extends back to the earliest internal combustion engines. One of the first prototypes of the diesel engine was designed to run on vegetable oil and several of Henry Ford's early cars ran on bioethanol rather than petrol.

Low crude oil prices through much of the twentieth century meant further demand for and development of biofuels was limited until the oil shocks of the 1970s. The resulting high oil prices forced many countries to begin research into the development of alternative fuel options. In many of these countries the range of benefits from biofuel production and use has seen much of the research and development continue today.

The benefits of biofuels

Biofuels are produced from biological, non-fossil sources. By using biofuels we are reducing New Zealand's reliance on imported crude oil, increasing the use of renewable energy and reducing our overall emissions of carbon dioxide, which contribute to global climate change. Currently in New Zealand the transport sector is responsible for 45% of our greenhouse gas emissions.

As biofuels are produced from biological material they are to varying degrees 'carbon neutral', which means they do not put extra CO₂ into the atmosphere – unlike fossil fuels. The biological material that biofuel is made from absorbs CO₂, which balances out the CO₂ released when biofuel is used – and that is good news for the environment.

Biofuel sustainability

It is important that biofuels have a positive overall impact on the environment – that is, they should be sustainable. The key factors when considering the sustainability of biofuels are CO₂ and other greenhouse gas emissions, energy balance (including in any fertilizer production and use), biodiversity conservation, soil conservation, water use, air quality and impact on food production and prices.

There is no internationally agreed set of sustainability standards at present. The criteria to determine the sustainability of biofuels is currently under active discussion around the world and here in New Zealand. However, New Zealand is very well placed to produce or access sustainable biofuels both today and in the future.



Biodiesel

Biodiesel is produced from vegetable oils or animal fats and can be used as a substitute for normal diesel.

Production: Biodiesel is produced by reacting vegetable oils or animal fats with alcohol. This reaction produces a mono-ester (biodiesel) and a by-product, glycerol. Glycerol is the thick, sticky component of oils and fats that causes problems in engines. The glycerol by-product is valuable for its use in producing soap and cosmetics.

Biodiesel production plants are mostly made up of storage tanks. The actual production equipment itself is relatively small and often housed inside a commercial building.

Sources: The source material used to produce biodiesel varies from country to country, with the lowest value, easiest produced oil or fat forming the majority of the supply. In Northern Europe this is rapeseed or canola oil, in Southern Europe sunflower oil, in Asian and other tropical regions coconut, palm or palm kernel oil and in the United States soy bean oil.

In New Zealand the single biggest potential source of biodiesel is tallow, an animal fat that is a by-product of meat processing. Currently small amounts of tallow are used in New Zealand for stock feed and food production, but the majority is exported to the Asian region for use as stock feed, in the production of hard soaps and in the chemical industry.

Currently New Zealand produces around 150,000 tonnes of tallow per year domestically, most of which could be available to convert into biodiesel. This would be sufficient to make enough biodiesel to supply approximately 5% of the country's annual diesel consumption. Other products such as used cooking oil from restaurants and oil and fat by-products from commercial food production could also be made into biodiesel.

Using biodiesel made from existing New Zealand by-product tallow can reduce greenhouse gas emissions by 93%.

Overseas use of biodiesel: Biodiesel has been in use overseas for nearly twenty years. With extensive diesel engine use in passenger vehicles and incentives for biodiesel use, Europe has been the centre of biodiesel growth.

Countries that currently produce and use biodiesel include most of the European countries, the United States, Canada and Australia. EU countries have targets for the use of biofuels, which are primarily met by biodiesel.



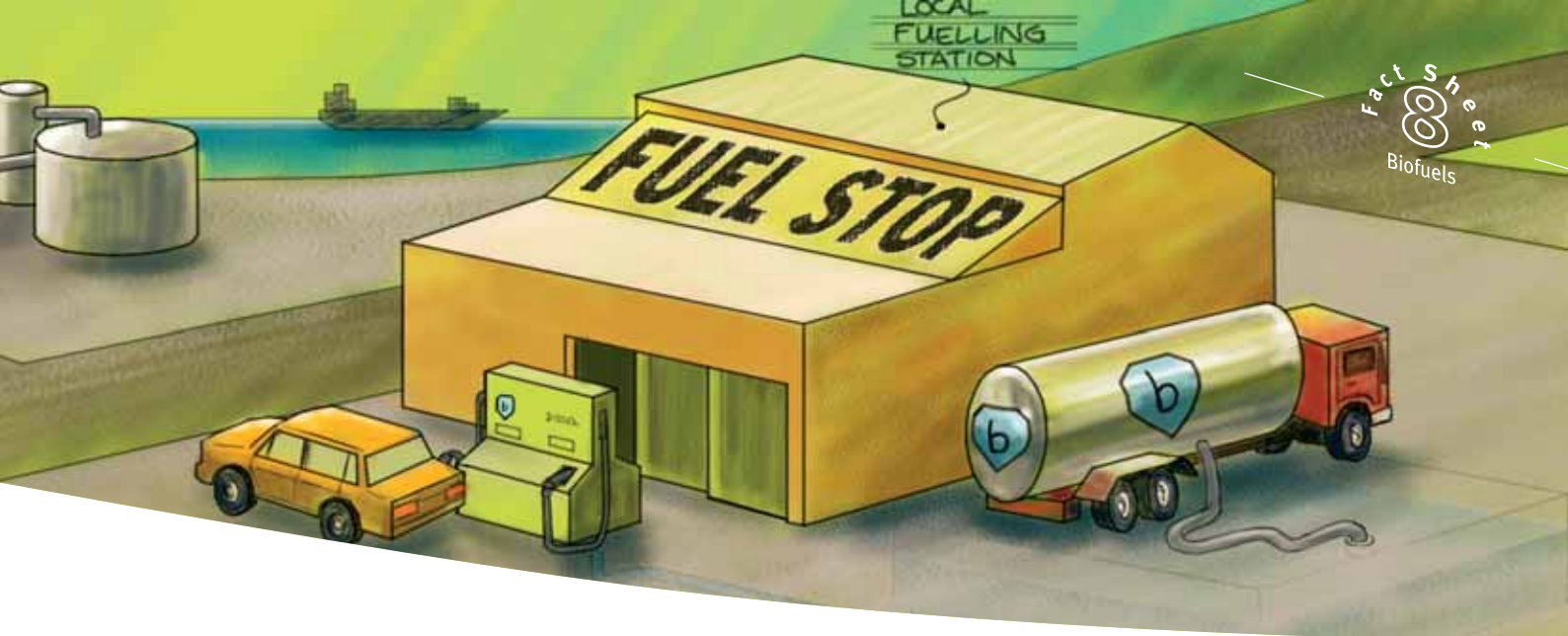
Biodiesel pump in the United States.
Image courtesy of www.topiaenergy.com

The most commonly available supply of biodiesel is as a 5% blend with normal diesel (B5). In many countries a B5 blend is considered the same as normal diesel under fuel specifications.

For use in specific locations, such as urban areas and national parks or in well-managed fleets of vehicles such as buses or trucks, it is common to use biodiesel anywhere from 20% (B20) blends to 100% (B100).

Benefits of using biodiesel: As well as being renewable and having climate change benefits, biodiesel has a number of other benefits over mineral diesel.

- Biodiesel is biodegradable, non-toxic and less hazardous than ordinary diesel. Spills on land or in water cause relatively little impact. When spilt in aquatic environments, biodiesel forms globules rather than a slick and these globules are broken down by bacteria. Even small amounts of biodiesel mixed with mineral diesel will speed up the breakdown of any fuel spills.



- Biodiesel has better lubrication properties than mineral diesel, so it can reduce engine wear.
- Using biodiesel can result in reduced engine deposits, reduced carbon monoxide, and hydrocarbons.
- Using biodiesel can result in reduced particulate exhaust emissions, which are a major cause of air pollution in cities like Auckland and have serious long-term health impacts for people exposed to them. Particulates come from incomplete combustion of mineral diesel, and are primarily fine soot particles. The larger, visible particles are seen as smoke, but the smaller, invisible particles are also concerning as they can be absorbed deep into the lungs.

Challenges when using biodiesel: Not all vehicle manufacturers have designed their engines for biodiesel. While 5% biodiesel blends can be used in all diesel vehicles, provided given fuel specifications are still met and the biodiesel component meets quality specifications, the majority of vehicle manufacturers do not approve the use of blends higher than 5% biodiesel.

Care needs to be taken with storage of the biodiesel blends such as keeping them free of water. Tallow biodiesel blends can form solids within the liquid fuel in storage tanks in cold weather, although this is not expected to be an issue in B5 blends in most of New Zealand.

The economics of biodiesel change with commodity and oil prices and the cost of the source material from which biodiesel is made. Biodiesel may be more expensive than diesel, but it can be in the national interest to use biodiesel if the reduction in particulate matter and net carbon dioxide emissions and other benefits are taken into consideration.

Biodiesel use in New Zealand: Biodiesel for public use in New Zealand would likely be sold as a 5% maximum blend with normal diesel. At this level there are not expected to be any compatibility issues with existing diesel engines, and no vehicle modifications are needed before it is used.

For fleet use and for specific applications, biodiesel can be used at any blend from 5% up to, in some cases, 100%. Diesel fleets such as buses and trucks would be most suited to use 20% blends of biodiesel depending on which part of the country they operate in, with higher blends being possible in warmer regions. Users in sensitive land or marine areas may look at using higher blends in order to maximise the environmental benefits of biodiesel and minimise the risks posed by diesel spills.

Bioethanol

Bioethanol is the same alcohol that is found in alcoholic drinks and the main alcohol contained in 'methylated spirits'. It is different from methanol, another alcohol sometimes used as a motor fuel in special vehicles, particularly race cars.

Production and sources: Bioethanol is most commonly made from products containing sugars and starches, through a process of fermentation and distillation. Emerging technology allows bioethanol to also be made from cellulose from crop residues (such as straw and corn stover), forestry wastes (sawdust etc), municipal solid waste and recycled paper.

In New Zealand, bioethanol is made as a by-product of the dairy industry by fermenting the lactose (milk sugar) in whey, with special yeast that converts this sugar into alcohol.

The dilute alcohol is then distilled into bioethanol. Most bioethanol made in New Zealand is currently exported.

In other countries bioethanol is produced from by-products of the grain industry (Australia), from sugar cane (Australia and Brazil) or corn grown specifically for bioethanol production (United States).

Overseas use of bioethanol: The United States and South American countries, with access to large volumes of sugar and starch crops, have experienced the greatest growth in bioethanol production and use.

Total world production of bioethanol is around 40 billion litres, 75% of which is used as fuel. Brazil is the world leader in bioethanol production and use. All cars in Brazil use 20 – 24% bioethanol, and some 'flex fuel vehicles' use 85% (E85) to 100% (E100) bioethanol.

Motorists in some parts of the United States have had bioethanol in their petrol for nearly 20 years and over 10% of all petrol sold there contains bioethanol. A blend of 10% bioethanol in petrol (E10) is most commonly used in the United States and Canada in unmodified petrol vehicles. Flex-fuel vehicles, which can use either petrol or E85, are also used in the United States and Canada.

Benefits of using bioethanol: As well as being renewable and having climate change benefits, the use of bioethanol can reduce emissions of carbon monoxide and hydrocarbons. This emission reduction is particularly evident in older vehicles with less sophisticated fuel management systems.

Challenges when using bioethanol:

Water can be a challenge when using bioethanol.

- In cars, care needs to be taken the first time bioethanol blended petrol is used, in case there is water present in the fuel tank. To minimise the risk of any problems, the first fill using bioethanol-blended petrol should be as large as possible — ensure your tank is nearly empty, then top it right up. If a small amount of water is present this will be absorbed by the fuel and the fuel system will stay dry after this.
- If your vehicle is more than ten years old, is not in good condition or you suspect there is water in the tank, a mechanic may need to check your vehicle. This includes checking for water in the fuel tank (and, if necessary, cleaning out the tank and fuel lines) and checking the condition of fuel hoses and seals.
- It should also not be used in vehicles or power tools which may be left unused for some time, as the fuel may absorb water from the air over time.
- Bioethanol blended petrol should not be used in aircraft, boats or other marine applications.

In some vehicles, the use of bioethanol can increase emissions of nitrogen oxides, making air quality problems worse in cities where nitrogen oxides are a problem. However, the greater use of modern engine technologies, which include oxygen sensors and engine management systems to correct air-fuel ratios, and catalysts to reduce emissions of nitrogen oxides, will eliminate this problem.

As it is with biodiesel, the economics of bioethanol change with commodity and oil prices and the cost of the source material from which bioethanol is made. Bioethanol may be more expensive than petrol, but using it has wider environmental benefits for the country.

Bioethanol use in New Zealand: Bioethanol was first introduced to New Zealand motorists as a 10% blend in petrol (E10), as allowed for in legislation. However, other blends, for instance, E3 (a 3% blend) and E5 (a 5% blend) are also possible. All bioethanol-blended petrol is required to be labelled at the pump and consumer information made available at the point of sale.

Many vehicles can use 10% ethanol blends without modification. Petrol blended with 3% bioethanol can be used in almost all petrol engines including used Japanese imports. It is totally acceptable to have bioethanol-blended petrol in your tank together with ordinary petrol. You can 'mix and match' and use it whenever you like, provided your fuel tank remains free of water.

Buying bioethanol-blended petrol: When you buy bioethanol-blended petrol from service stations and suppliers you can be sure that the fuel is good for your car. Government regulations for bioethanol-blended petrol can give you confidence that the fuel meets quality specifications.

To find out where you can buy biofuel blends, and for further information on biofuels, visit www.biofuels.govt.nz

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www.eeca.govt.nz

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