

Alternative Fuel

Which one do you
make the

choose as the best for the economy as well as the environment? You
choice.



LPG/Propane Fuel



Electric Vehicle

Bio-Diesel

Biodiesel is a fuel that can be made from vegetable oils, recycled cooking oils from fast food restaurants, and certain animal fats, such as fish oil or beef tallow. Biodiesel can be used in any diesel engine in place of diesel fuel. Little or no engine modification is necessary because diesel engines were originally designed to run on a variety of fuels. Biodiesel has a solvent effect that may release deposits accumulated on tank walls and pipes from previous diesel fuel usage. The release of deposits may end up in fuel filters initially, so fuel filters should be checked more frequently at first. Ensure that only fuel meeting the biodiesel specification is used.



Biodiesel is easy to make and store, and is safer to transport than diesel fuel. It helps increase engine life. Using it reduces the consumption of fossil fuels. Compared to diesel fuel, biodiesel produces almost no pollutants and significantly reduces carbon dioxide emissions. It's also more pleasant to use--the exhaust from a biodiesel vehicle often smells like popcorn or French fries! In some regions of the U.S., biodiesel is becoming popular as a fuel for agriculture equipment, such as tractors and trucks, as well as for passenger vehicles.

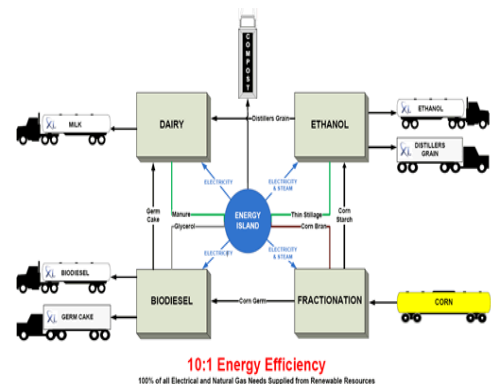
Biodiesel delivers similar horsepower, torque, and miles per gallon as conventional diesel, while producing significantly lower emissions of Carbon Monoxide, black smoke, and particulate matter.

The average cost, within Arizona, is approximately \$2.85 - \$3.85 per gallon. Using a 2% blend of biodiesel is estimated to increase the cost of diesel by 2 or 3 cents per gallon, including the fuel, transportation, storage and blending costs. Any increase in cost will be accompanied by an increase in diesel quality since low-blend levels of biodiesel greatly enhance the lubricity of diesel fuel.



Biodiesel Tractor

XL Biorefinery



Ethanol



Ethanol is a clear, colorless liquid. As a diluted solution, it has somewhat sweet flavor, but in more concentrated solutions it has a burning taste.

E10 refers to a gasoline-based ethanol product. This has a combination of 90% gasoline 10% ethanol. E10 is commonly used throughout the United States and can be used in all gasoline vehicles without engine modification.

E85 is a blend of 85% ethanol and 15% gasoline. Flexible-fuel vehicles (FFVs) are designed to run on regular unleaded or any ethanol fuel blend up to 85% Ethanol. Special onboard diagnostics "read" the fuel blend enabling drivers to fuel with E85 or regular unleaded if E85 is not available.

The color yellow symbolizing the color of corn has become associated with the fuel and is commonly used on fuel pumps and labels.

Ethanol is increasingly used as an oxygenate additive for standard gasoline, as a replacement for MTBE, which is responsible for considerable groundwater and soil contamination.



Ethanol is an abundant new source of energy for the future that also helps conserve natural petroleum resources.



Ethanol Facts:

1. Ethanol is made by fermenting & distilling starch crops.
2. Corn, barley, wheat, sorghum, potatoes, sugarcane and cellulose can all be used to make ethanol.
3. It is biodegradable.
4. Pure ethanol is not typically used as a motor fuel. It is blended with gasoline for use in vehicles.
5. In 1908, Henry Ford designed the Model T to run on a mixture of ethanol and gasoline.
6. Ethanol was banned in 1919 because it was considered alcohol under Prohibition.
7. Since most U.S. ethanol is made from corn, droughts and crop shortages can affect

price and supply.

8. A gallon of ethanol yields less energy than a gallon of regular fuel, meaning that fuel efficiency is slightly decreased.
9. "Flex fuel" vehicles can run on ethanol blends as well as traditional fuels.
10. Ethanol blends can damage engines without the proper equipment. Check your owner's manual before filling up.

Hydrogen

How is Hydrogen made?

Since hydrogen doesn't exist on earth as a gas, we must separate it from other elements. We can separate hydrogen atoms from water, biomass, or natural gas molecules. The two most common methods for producing hydrogen are **steam reforming** and **electrolysis** (water splitting). Scientists have even discovered that some algae and bacteria give off hydrogen.

- **Steam reforming** is currently the least expensive method of producing hydrogen and accounts for about 95 percent of the hydrogen produced in the United States. It is used in industries to separate hydrogen atoms from carbon atoms in methane(CH_4). Because methane is a fossil fuel, the process of steam reforming results in greenhouse gas emissions that are linked with global warming.
- **Electrolysis** is a process that splits hydrogen from water. It results in no emissions but it is currently a very expensive process. New technologies are being developed all the time.

Hydrogen can be produced at large central facilities or at small plants for local use. Every region of the country (and the world) has some resource that can be used to make hydrogen. Its flexibility is one of its main advantages.

Hydrogen has great potential as an environmentally clean energy fuel and as a way to reduce reliance on imported energy sources. Before hydrogen can play a bigger energy role and become a widely used alternative to gasoline, many new facilities and systems must be built. We will need facilities to make hydrogen, store it, and move it. We will need economical fuel cells. And consumers will need the technology and the education to safely use it.



CNG Fuel



What is CNG?

Compressed natural gas, or CNG, is natural gas under pressure which remains clear, odorless, and non-corrosive. Although vehicles can use natural gas as either a liquid or a gas, most vehicles use the gaseous form compressed to pressures above 3,100 pounds per square inch.

Compressed natural gas is a cleaner burning alternative fuel, used in place of diesel fuel or traditional petroleum fuel. Although this may sound like something that you have never heard of, it is quite possible that your school buses are running with the help of compressed natural gas as a fuel. It used to be that using this type of alternative fuel was a thing of the future, something that humans hoped to be able to make use of in face of this fossil fuel crisis; these days, compressed natural gas is something that is real and apparent and it is used each and every day, even though you may not even realize it.

Of course, with everything good that comes along with compressed natural gas as an alternative fuel type there has to be a downside, right? The main downside to using this type of fuel in place of traditional fuel is that it takes up a significantly larger amount of space than traditional fuel. It is stored in large barrels and compressed inside there, and since it is a gas rather than a liquid there is really no way of getting around this extra space. At the same time, it really isn't much cheaper than traditional gas and there does have to be different types of engines in place in order for a vehicle to properly process this type of fuel. This is one of the main reasons why at this point it is normally used in larger trucks and buses and not so much in traditional family vans or passenger cars.

Are Natural Gas Powered Vehicles safe?

Natural gas is an ideal fuel source for many reasons, including safety. Natural gas is lighter than air. This means that it will not puddle (like gasoline) or sink to the ground like propane, which is heavier than air. Instead, natural gas will rise and disperse into the atmosphere.



Natural gas also has a higher ignition temperature. This means that it is much harder to ignite. Also the storage systems used for compressed natural gas are infinitely stronger than the gasoline tanks found on cars and trucks today.

Although compressed natural gas does have its drawbacks, it is important to realize the impact that using such a clean burning alternative fuel can have on the environment. Not only does it help to reduce dependence on foreign oils for the continuance of everyday living, but it also makes for a step in the right direction toward finding alternatives to traditional gasoline that most people may not even know exist.

LPG Fuel (Propane)



Courtesy of The National Renewable Energy Laboratory (NREL)

It's not a new idea: Propane-powered vehicles have been around for decades. The benefits include **reduced emissions**, quoted by WLPGA ([World Liquefied Petroleum Gas Association](#)) as "50% less carbon monoxide, 40% less hydrocarbons, 35% less nitrogen oxides (NOx) and 50% less ozone forming potential compared to gasoline". With government incentives and tax breaks figured in, LP gas used in cars (known as **autogas**) can be much cheaper than gasoline. Even without the incentives, it is usually much cheaper. Autogas is a high-octane fuel, offering performance

comparable to gasoline and diesel, and many owners claim that autogas runs more smoothly, resulting in less wear and tear on engine components.

With propane, a greater quantity is required to travel the same distance. But because of its gaseous form, the engine runs more efficiently which helps offset the extra propane consumed. The greatest environmental benefit comes from reduced evaporative losses, including those which occur during refueling. This is because the propane fuel system is effectively sealed. As well, the natural tendency to form ground-level ozone is half that of gasoline and propane does not contain lead or sulfur which contribute to acid rain.

LPG has a long and varied history in transportation applications. It has been used in rural and farming settings since its inception as a motor vehicle fuel.

Over time, propane has been used in several areas such as for forklifts, both inside and outside warehouses, and at construction sites. Use of propane can result in lower vehicle maintenance costs, lower emissions, and fuel costs savings when compared to conventional gasoline and diesel. Presently, domestic automakers have reduced their offerings of vehicles that can operate using

propane and other gaseous fuels; this has placed renewed emphasis for the conversion or of new vehicles to operate on propane and compressed natural gas.



Electric



Electric vehicles (EVs) are cars that run on electricity stored in batteries. EVs are often confused with hybrid electric vehicles which combine an internal combustion engine with a battery. EVs are truly zero emission cars because they have no tailpipe exhaust and no evaporative emissions from fuel systems. Manufacturers have developed a broad range of EVs-- from neighborhood electric cars which

can be used for short trips around town to full function electric cars which can be used for longer trips and have the body of conventional cars.



There are many perks and conveniences in driving a battery electric car:

- ✦ Drive alone in the HOV lane-- bypass all the traffic
- ✦ Tax incentives
- ✦ Recharge at your home or work
- ✦ Fuel costs are less than a conventional car. By driving an electric vehicle with a 30-mile commute, you can reduce gasoline consumption by an estimated 750 gallons annually.
- ✦ Maintenance costs are lower because there are fewer moving parts to service and repair

- ✦ No noisy engine

The availability and styles of these vehicles vary from year to year, but with battery technology getting more sophisticated, manufacturers will have the ability to design electric vehicles with extended range, faster charging and more power.

