

Alternate Fuels for Automobiles

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Abstract: World fuel consumption has been steadily increasing for a variety of reasons, which include enhancements in quality of life, population increase, industrialization, rapid economic growth of developing countries, increased transportation of and goods, etc. The entire surface transport of India is based on petroleum fuel, but its availability is of growing concern. The production of domestic crude has been declining and the transport system has been increasingly dependent on imported crude oil to meet its needs. Fuel costs are rising at record highs around the world. Scientist and entrepreneurs are searching for solutions that will ease the pain at the gas pump. The price of petroleum and diesel are more expensive than ever and with no sign of any relief in sight people are now paying almost double what they were just two short years ago. Many people are obviously concerned and unsure about what they should do in the future. People can't afford to continue paying these prices and higher as well as the direct cost it also has on goods in the supermarket. Most people, especially those with families, still need a vehicle for regular day to day tasks and if not that, even just for emergencies. As a solution for this problem Scientists are developing alternative fuels that can help not only the environment, but also the consumer's checkbook. The new alternative fuels offer advantages in so many ways that people are really starting to take a look at these as an option over paying astronomical gasoline prices.

Keywords: petroleum fuel, concerned, alternate fuel, astronomical gasoline

1. INTRODUCTION

An alternative fuel is one that is not produced by using crude oil. They are simply fuels that replace conventional gasoline as a means of powering vehicles. The term "alternative fuels" usually refers to a source of which energy is renewable. Renewable energy is the energy from renewable sources like

- ❖ wind power
- ❖ solar power
- ❖ tidal power
- ❖ geothermal power
- ❖ hydropower

Alternative fuels have desirable energy efficiency and pollution reduction features. The 1990 Clean Air Act encourages development and sale of alternative fuels. More specifically; the Energy Policy Act (EP Act) of 1993 gave a more in-depth definition of what

they consider to be alternative fuels. Alternative fuels, also known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels. Conventional fuels include: fossil fuels (petroleum (oil), coal, propane, and natural gas), and nuclear materials such as uranium. Some well known alternative fuels include biodiesel, bioalcohol (methanol, ethanol, butanol), chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil and other biomass sources.

The United States Department of Energy recognizes the following as alternative fuels:

- ❖ Mixtures containing 85% or more by volume of alcohol fuel, including
- ❖ methanol and denatured ethanol
- ❖ Natural gas (compressed or liquefied)
- ❖ Liquefied petroleum gas (propane)
- ❖ Hydrogen
- ❖ Coal-derived liquid fuels
- ❖ Fuels derived from biological materials
- ❖ Electricity (including electricity from solar energy)
- ❖ 100% Biodiesel (B100)

II. TYPES OF ALTERNATE FUELS FOR AUTOMOBILES:

- ❖ Biodiesel
- ❖ Biogas
- ❖ Biomass
- ❖ Electricity
- ❖ Ethanol
- ❖ Methanol
- ❖ Hydrogen
- ❖ Compressed Natural Gas
- ❖ Liquefied Natural Gas (LNG)
- ❖ Liquefied Petroleum Gas (LPG, commonly known as propane)

Biodiesel:

Fuels for diesel engines made from sources other than petroleum are known as biodiesel. Probably one of the most exciting alternative fuels that are being developed is biodiesel fuel. Biodiesel is a renewable fuel produced from agricultural resources such as vegetable oils and it is a clean burning alternate fuel. Biodiesel fuel is a lot like diesel fuel, but it is made from vegetable oil or animal fat. Biodiesel is not regular vegetable oil and is not safe to swallow. Biodiesel is biodegradable though, so it is much less harmful to the environment if spilled. Ordinary diesel engines can run on biodiesel. Modern diesel engines can run on 100 percent biodiesel with little degradation in performance compared to petrodiesel because the BTU content of both fuels is similar--120,000 to 130,000 BTU per gallon. Rudolf Diesel was the one who demonstrated a Diesel engine running on peanut oil built by the French Otto Company at the World Fair in Paris, France in 1900. Though it powered by peanut, that was not biodiesel. Lots of researches were done on biodiesel all through this time. But in 1977, Expedito Parente, a brazilian scientist produced biodiesel using transesterification with ethanol. In 1979, South Africa initiated the research into the use of transesterified sunflower oil and refining it to diesel fuel standards. By 1983, the process for producing fuel quality, engine-tested biodiesel was completed and published internationally. Large number of Bio diesel plants were opened in many countries including Germany, Sweden and Czech Republic in the 90s. It is proved that Vehicles have similar horsepower and torque as

conventional diesel when running on biodiesel. The price of biodiesel blends can vary depending on geographic area, base material (corn, soybeans, etc.), and supplier.

SOURCES OF BIODIESEL:

Biodiesel commonly uses soybean or canola oil as its base, but animal fat or recycled cooking oil can also be used. Biodiesel is made through a process called transesterification. This process makes vegetable oil and animal fat into esterified oil, which can be used as diesel fuel, or mixed with regular diesel. Practically any type of vegetable oil or animal fat can be used to make biodiesel. But the most popular types of vegetable oils are soybean and rapeseed oil.

ADVANTAGES OF BIODIESEL:

- ❖ Biodiesel is harmless, eco-friendly and biodegradable.
- ❖ The biodiesel has a very high cetane number and this high cetane numbers of biodiesel assists to easy cold starting and low idle noise.
- ❖ Other major advantage is that the life of diesel engines is extended with the biodiesel, because it is more lubricating and additionally, power output is comparatively unaltered by biodiesel.
- ❖ The eco-friendly biodiesel fuel substitutes the exhaust odor of petroleum diesel with a more pleasant smell of popcorn or French fries.

III BIOGAS

It is a type of gas that is formed by the biological breakdown of organic matter in an oxygen deficient environment. It is counted as an eco friendly biofuel. Biogas is an alternative fuel for powering vehicles as a substitute to petrol and diesel. Biogas is a mix mainly of methane and carbon dioxide and is produced naturally when organic matter decomposes in the absence of oxygen. Biogas is produces from Land filling and through anaerobic digestion. Depending on place where it is produced, biogas can also be called swamp gas, marsh gas, and landfill gas or digester gas.

Sources of biogas:

It is a combustible gas derived from decomposing biological waste. Biogas normally consists of 50 to 60 percent methane gas Biogas generated by fermenting organic matter--including byproducts of sewage and manure. Anaerobic digestion is one of the methods through which biogas is produced. Biogas can be produced utilizing anaerobic digesters. Here, the plants can be fed with energy crops such as maize silage or biodegradable wastes including sewage sludge and food waste; whereas, the landfill gas is produced by organic waste decomposing under anaerobic conditions in a landfill. Gobar Gas is the other form of biogas generated out of cow dung. This type of biogas is produced mainly in the households of India and Pakistan.

DISADVANTAGES:

- ❖ Biogas has many advantages over other alternative fuels
- ❖ One of the main advantages of biogas is that the technology is cheaper and much simpler than those for other biofuels.
- ❖ Dilute waste materials can be used as substrate.

Biomass:

Biomass is defined as organic matter, such as wood, crops, and animal wastes. Solar energy powers photosynthesis, which stores that energy in the form of plant matter. Therefore, biomass is stored solar energy

Sources of Biomass:

The two primary sources of biomass fuels, forest-residue chips and Salix chips Woody and Herbaceous energy crops, Wood energy crops, Herbaceous energy crops, Grains and sugar crops, Agricultural and forestry residues, Municipal solid wastes, Agricultural manures

Advantages of Biomass:

- ❖ Biomass is far more widely available than fossil fuels and, with good management practices, can be produced renewably.

- ❖ Modernized biomass energy can provide a basis for rural development and employment in developing countries, thereby helping curb urban migration
- ❖ In developing countries, growing biomass for energy on deforested and otherwise degraded lands might provide a mechanism for financing the restoration of these lands.

Electricity:

Electricity can be made by many means, from the burning of high-sulfur coal to pollution-free photovoltaic cells (or solar cells). Electric vehicles are generally divided into battery and hybrid classes, depending on whether the electricity is generated off-board and stored in a battery or generated by a small on-board power plant. Hybrid electric vehicles can be designed to run on any fuel, including gasoline or diesel as well as alternative fuels, and can best be thought of as highly-efficient gasoline, diesel, or alternative-fueled vehicles

ADVANTAGES OF Electricity:

- ❖ Electric vehicles expels low pollution when compared to other vehicles
- ❖ electric vehicles are very efficient
- ❖ It regenerate high power and saves it in battery

Ethanol:

Ethanol is a form of alcohol; in the United States, it is produced mainly from corn. The starch in the corn is converted to sugar, which is fermented to produce the fuel, a process not unlike making corn liquor in a still. Ethanol fuel, typically blended with 85% ethanol, 15% unleaded gasoline and sold as E85. Ethanol is sometimes called grain alcohol. The alcohol found in alcoholic beverages is ethanol. Ethanol is colorless and flammable as well as being the alcohol in alcoholic drinks

Sources of ethanol:

One of the most common sources ethanol is made from is corn. It is an alcohol and is fermented from sugars, starches or from cellulosic biomass. Most commercial production of ethanol is from sugar cane or sugar beet, as starches and cellulosic biomass usually require expensive pretreatment. It is used as a renewable energy fuel source as well as being used for Manufacture of cosmetics, pharmaceuticals and also for the production of alcoholic beverages. The process of manufacturing ethanol is very simple. Usually, it is made from the common crops such as sugar cane and maize and it can also be produced from biogases, miscanthus, sugar beet, sorghum, grain sorghum, switch grass, barley, hemp, kenaf, potatoes, sweet potatoes, cassava, sunflower, fruit, molasses, corn, Stover, grain, wheat, straw, cotton etc. The process of making ethanol is not so expensive. As we know plants make glucose by the process called photosynthesis, but in the ethanol fermentation glucose is decomposed into ethanol and carbon dioxide. During the combustion ethanol reacts with oxygen to produce carbon dioxide, water and heat. Generally Ethanol is considered as renewable energy as it is the result of the conversion of sun's energy. Ethanol is now commonly used to power automobiles. USA, Brazil, China, India and France are the five top ethanol producers in the world and in it Brazil and USA are the top most with 70 percent of ethanol production. First vehicle which used ethanol as fuel was Fiat 147 built in July 1979. Ethanol can be created biologically by fermenting, an energy production processes requiring no oxygen, sugars with yeast.

Advantages of ethanol:

- ❖ Ethanol has a high octane rating (108+), which is beneficial in engines that are designed to operate on higher octane fuels.
- ❖ Almost the price of Ethanol fuel will be cheaper compared to other fuels.
- ❖ Availability is the greatest advantage of this alternative fuel
- ❖ It will strengthen the vehicle by giving more mileage and less maintenance

Methanol: Methanol (CH₃OH) is an alcohol fuel formed from natural gas, coal, or biomass feed stock. Methanol is also called 'wood' alcohol. Methanol is toxic, and ingestion can cause blindness and death. Methanol has been used as vehicular fuel since the early 1900s, and is also used as a fuel for diesel engines and fuel cells. Pure methanol is labelled M100, and a mix of 85% methanol and 15% gasoline is labelled M85. M85 has an octane rating of 102 Methanol has been adopted as a racing fuel, both for performance and safety reasons. Since methanol mixes with water, a methanol fire can be extinguished with water, which is not the case for gasoline. Methanol is produced by a process of chemical conversion. It can be produced from any biomass with moisture content of less than 60%; potential feedstocks include forest and agricultural residues, wood and various energy crops. As with ethanol it can either be blended with gasoline to improve the octane rating of the fuel or used in its neat form. Both ethanol and methanol are often preferred fuels for racing cars. The use of methanol as a motor fuel received attention during the oil crisis of the 1970's due to its availability and low cost.

Sources of Methanol:

Methanol is sometimes called wood alcohol and can be made from various biomass resources like wood, as well as from coal. However, today nearly all methanol is made from natural gas, or methane, because it is cheaper. Methanol is the simplest alcohol chemically, containing one carbon atom per molecule. Commonly known as "wood alcohol," it is a toxic, colorless, tasteless liquid with a very faint odor. Because it is produced as a liquid, methanol is stored and handled like gasoline. Most methanols is currently made from natural gas, but it can also be made from a wide range of renewable sources, such as wood or waste paper.

Advantages of Methanol:

- ❖ Fine anti-knock property
- ❖ Lower emissions
- ❖ Lower risk of flammability
- ❖ Higher performance
- ❖ Octane number of methanol is higher than 110, which is much higher than common gas oil
- ❖ Lower generalization cost. Steam pressure of methanol is less than fuel pressure, the specific
- ❖ Gravity is high, not volatilizable to fuels, and the fire hazard is lower.

Hydrogen -One of the most interesting and promising, alternative transportation fuels is hydrogen. While mostly only experimental vehicles are operating on this fuel now, the potential for this unique energy source is excellent. hydrogen is the lightest of all elements. Hydrogen is normally a gas and can be compressed and stored in cylinders. Hydrogen gas is the most abundant element on the planet Hydrogen (H₂) is colorless, odorless, and non-toxic, and hydrogen flames are invisible and smokeless.

Sources of Hydrogen:

Hydrogen does not occur free in nature; it can be made by "re-forming" natural gas or another

fossil fuel, or by using electricity to split ("electrolyze") water into its components of oxygen and hydrogen. In this sense, hydrogen is like electricity: the energy to generate it can be obtained from sources ranging from the burning of high-sulfur coal to pollution-free photovoltaic cells (solar cells). Hydrogen is projected as possible fuel of the future. Hydrogen (H₂) can be produced from many different feedstock's, including natural gas, coal, biomass, and water. The production processes include steam reforming of natural gas, presently the most economical method, electrolysis of water, and gasification of coal, which also produces CO₂.

Advantages of hydrogen:

- ❖ Hydrogen can be used as fuel for Internal Combustion Engine or Fuel Cell.
- ❖ Bi-fuel engines have been used with hydrogen, in which hydrogen is used at start up and low load, and gasoline at full load to reduce cold start emission levels.
- ❖ The present the largest user of hydrogen is the aerospace community for rocket fuel
- ❖ High octane number, and when used at a fuel equivalence ratio of 0.6 (67% excess air), compression ratio of about 14 can be utilized without serious knock problems.
- ❖ Low emissions. Essentially no CO, CO₂ or HC in the exhaust as there is no carbon in the fuel.
- ❖ NO_x emissions can be kept low if the engine is operated at low fuel equivalence ratio
- ❖ Fuel leakage to the environment is not problem
- ❖ no greenhouse gases are generated because there's no carbon in the fuel
- ❖ The advantage of using hydrogen to store energy rather than a battery pack is that a hydrogen tank can be refilled in minutes rather than recharged in hours
- ❖ Hydrogen gas is the most abundant element on the planet

Liquefied Petroleum Gas (LPG):

Most people call liquefied petroleum gas (LPG) "propane." That is because LPG is mostly made up of propane. Actually, LPG is made of a mixture of propane and other similar types of hydrocarbon gases. Different batches of LPG have slightly different amounts of the different kinds of hydrocarbon molecules. These hydrocarbons are gases at room temperature, but turn to liquid when they are compressed. LPG is stored in special tanks that keep it under pressure, so it stays a liquid. The pressure of these tanks is usually about 200 pounds per square inch (abbreviated "psi").

Sources of Liquefied Petroleum Gas (LPG): Liquefied petroleum gas, as the name suggests, is partly a byproduct of petroleum refining; in California the state's oil refineries are the main source, but nationwide well under half of LPG comes from petroleum refining, and the rest from natural gas processing. It consists of hydrocarbons that are vapors, rather than liquids, at normal temperatures and pressures, but which turn liquid at moderate pressures; its main constituent is propane, and it is sometimes referred to by that name.

Most LPG produced in the U.S. comes from natural gas wellhead processing. That is because natural gas has LPG gases and water vapor in it, which must be removed before the natural gas can be sent away in pipelines. Most of the LPG produced in California comes from petroleum refining.

Table 2 Composition of LPG Types

Component	HD-5 Propane	Commercial Propane	Commercial B/P Mixture
Propane	90 % liquid volume (min)	Propane and / or propylene	Butanes and / or butylenes with
Propylene	5 % liquid volume (max)	-	propane and / or propylene
Butane and heavier HC	2.5 % liquid	2.5 % liquid	-
Moisture content	Dryness test of NGPA	Dryness test of NGPA	-
Residual Matter	0.05 ml	0.05 ml	-
Pentane and heavier HC			2 % liquid volume (max)
Total sulfur	123 PPMW	185 PPMW	140 PPMW

Advantages of Liquefied Petroleum Gas (LPG):

- ❖ LPG fueled engines can pollute less than gasoline and diesel engines
- ❖ LPG usually costs less than gasoline for the same amount of energy.
- ❖ In some Countries LPG is used much more for vehicle fuel.
- ❖ Propane vehicles can produce 60% fewer ozone-forming emissions (CO and NO_x) than vehicles powered by reformulated gasoline.
- ❖ In addition, tests on light duty, bi-fuel vehicles have demonstrated a 98% reduction in the emissions of toxics, including benzene, 1,3-butadiene, formaldehyde, and acetaldehyde, when the vehicles were running on propane rather than gasoline.

Alternative Fuel Vehicles:

There are two types of alternative fuel vehicles

– those that are originally designed to run on these new fuels and those that have been converted to run on alternative fuels. Car companies will also make hybrid vehicles that can run on either gasoline or other fuels. Many people call these cars “green vehicles” because of their positive effect on the environment.

Since the trend is toward producing and buying environmentally friendly vehicles, nearly every major car manufacturer has at least one green vehicle in their inventory. We’re relatively sure that as alternative fuels become more and more popular because of the cost and the positive effects on our environment, the number of green vehicles will dramatically increase in the next few years.

As of 2009, here is a list of some of the green vehicles manufactured by some of the major car companies:

- ❖ Honda Insight
- ❖ Honda Accord Hybrid
- ❖ Dodge Ram Pickup 1500 Series
- ❖ Dodge Stratus Sedan

- ❖ Dodge Durango SUV
- ❖ Dodge Caravan Minivan
- ❖ Ford Taurus
- ❖ Ford F-150 Pickup
- ❖ Ford Escape SUV
- ❖ GM Impala
- ❖ Chevrolet Silverado 4 x 2
- ❖ Chevrolet Tahoe SUV
- ❖ Chevy Yukon SUV
- ❖ Nissan Titan Pickup
- ❖ Toyota Highlander SUV
- ❖ Toyota Prius

Many of the vehicles listed above are hybrid vehicles which mean that they can run on both conventional gasoline as well as alternative fuels. As we said, the above list is for 2006 vehicles. The list for 2007 is much larger. There are also two other types of AFVs that are becoming more and more popular. First, there is the electric vehicle. This car is exactly what it says it is. You plug it into an electrical outlet to charge the battery and then drive without using any fuel at all. However, these vehicles are generally not meant to travel at high speeds. A second type of AFV is the fuel cell vehicle. These cars get electrical energy from a fuel cell instead of from a battery. There are different kinds of fuel cell vehicles, but most manufacturers prefer cells that use a proton exchange membrane that uses hydrogen to produce an electrical current to run the motor. The only type of exhaust with this type of vehicle is water – believe it or not. Besides the obvious advantages to owning an AFV, the government is also stepping in to make it even more advantageous. People who buy these types of vehicles are given tax breaks on their income taxes. Additionally, many states also offer incentives and car manufacturers even offer rebates or discounts.

Government Grants for Alternative Fuel:

The alternative fuel industry has grown in popularity over the years, and the Federal as well as State governments are getting involved like never before. Legislation is being introduced every day offering government grants for using alternative fuels. That means that research and technology can continue to progress as it has for several years now as scientists and researchers find new ways to provide us with power other than standard fossil fuels.

What types of government grants are available when it comes to the use of alternative fuels? Well, most of them involve businesses who are interested in converting their gas-powered vehicle fleets over to alternative fuel fleets that are environmentally friendly and will meet with the Energy Policy Act that President Bush signed in 2005. Businesses such as trucking companies use a large amount of fossil fuels. The increasing cost of gasoline makes their operating costs rise and, in turn, passed on to the consumer – that's us! When these companies begin to convert their trucks over to alternative fuel and get a government grant to pay for the cost, they're saving money, and so are we!

Of course, these government grants won't cover the cost of switching to alternative fuel sources entirely. However, many grants can amount to millions of dollars of free money with the companies only having to pay about half of what is required to convert engines. Some people don't agree with the thought of their tax dollars paying for something like paying for companies to convert vehicles to alternative fuel vehicles. However, if they really thought about the advantages, they might actually change their mind and begin supporting the government grant program for alternative fuel use. For example, allowing the government to provide grant money for those who want to use alternative fuels, we are decreasing our

dependence on foreign oil and thus becoming much more self-sufficient. This will also help with the alarming phenomenon of global warming, which is a reality, and has been brought to the forefront through ex-Vice President Al Gore's Oscar winning documentary "An Inconvenient Truth".

All of us in the United States should really be concerned about both of these problems: dependence on foreign oil and global warming. By getting involved with grant programs, the government is doing what it can to insure that we can find solutions to the problems instead of just sitting back and doing nothing. Alternative fuels are the wave of the future and having the support of the government through grant money can help make us a totally independent country when it comes to our energy sources.

2. CONCLUSION

Alternative fuels generally lower emissions making them appealing for environmental concerns. Many of these fuels are renewable and would lessen the need for petroleum products. A lot of these fuels are going to be used with the developing fuel cell technology. With making the public aware of these alternatives it could hasten the development of these fuels and the technologies to run them.

AKNOWLEDGEMENT

We would like to acknowledge with appreciation our Head of the Department Dr.G.Prabhakaran for actively motivating us throughout the project and also our college Jeppiaar Engineering college. Lastly our special thanks to our parents for their immense support