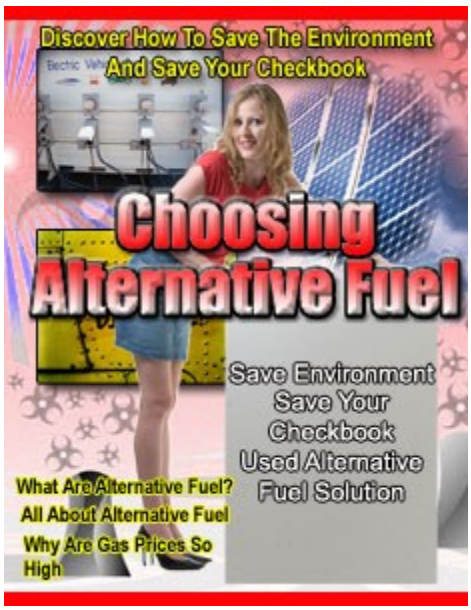

Choosing Alternative Fuel

A Publication of:

http://www.SuccessQuest.info

Choosing Alternative Fuel

How to Save the Environment and Save Your Checkbook

LEGAL NOTICE

The Publisher has strived to be as accurate and complete as possible in the creation of this report, notwithstanding the fact that he does not warrant or represent at any time that the contents within are accurate due to the rapidly changing nature of the Internet.

While all attempts have been made to verify information provided in this publication, the Publisher assumes no responsibility for errors, omissions, or contrary interpretation of the subject matter herein. Any perceived slights of specific persons, peoples, or organizations are unintentional.

In practical advice books, like anything else in life, there are no guarantees of income made. Readers are cautioned to reply on their own judgment about their individual circumstances to act accordingly.

This book is not intended for use as a source of legal, business, accounting or financial advice. All readers are advised to seek services of competent professionals in legal, business, accounting, and finance field.

You are encouraged to print this book for easy reading.

Table of Contents

INTRODUCTION

Gas prices in the United States are at an alarming rate these days. In some parts of the country, consumers are paying $3 to $4 a gallon. This can be devastating to people who depend on their cars for their livelihoods. It can put a huge dent in a family's budget and cause a real hardship.

Plus, with the rising price of gas, we have to consider the effect on our consumer goods as well. Trucking companies must pay more in fuel costs, and the only way for them to recoup any of that money and make even a small profit is to pass the increased cost on to the consumer. That means higher prices for things like groceries, clothing, and other things we need and use every day.

But there is hope on the horizon. 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.

Unlike back in the 1970's when there was a gas shortage invoking memories of long lines at gas stations, we have plenty of gasoline. But the prices are what is of concern today. Many people blame the high price of gas on our ongoing war in the Middle East, but what these people don't realize is that a majority of the oil we use to manufacture gasoline is obtained from Venezuela.

So why are gas prices so high? Oil is the most precious commodity in the world. It is more valuable than gold. The price per barrel has risen dramatically even in the past year. Perhaps it has more to do with supply and demand more than anything, but the real fact is that federal, state, and local taxes have a lot to do with the price per gallon of gasoline. In fact, 19 percent of the cost of a gallon of gasoline is attributable to these taxes.

The truth of the matter is that the development of these new alternative fuels helps consumers in so many ways. That's why it's so important to know as much as you can about the options that are available when it comes to alternative fuels and how they can help YOU as a consumer and how they can help US as world citizens.

Chapter 1 - What Are Alternative Fuels?

(Return to Contents)

In the simplest form, 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. 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. 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)

Pure biodiesel (B100) is considered an alternative fuel under EP Act. Lower-level biodiesel blends are not considered alternative fuels, but covered fleets can earn one EP Act credit for every 450 gallons of B100 purchased for use in blends of 20% biodiesel or higher.

Through the Alternative Fuel Petition Program, third parties can petition the Department of Energy to add alternative fuels to the above list. People are always on the lookout for new ways to combat rising fuel prices and develop fuels that are not only good for the environment, but for the consumer's checkbook as well.

Basically, alternative fuels include methane, propane, ethanol, and compressed gas among others. We'll examine some of these a little later in the book, but alternative fuels don't fall into one compact category other than the one that defines them as an option over gasoline.

It's kind of exciting to think about the fact that we can now power our vehicles using things like vegetable oil, animal fats, and even wood! It brings to mind the movie "Back to the Future" where Doc would power his DeLorean time machine using garbage as fuel!

Probably the biggest advantage to using alternative fuels is that they are very environmentally friendly. Some people believe that the pollutants that are released in the air from conventional gasoline are contributing to the global warming phenomenon. There's no doubt that the exhaust fumes produce smog and in large cities, this is a real problem.

In order to understand how alternative fuels can be a great option over conventional fuels, let's take a look at gasoline, how it's made, and what it does to the environment.

Chapter 2 - Gasoline And Oil

(Return to Contents)

In the United States and the rest of the industrialized world, gasoline is definitely a vital fluid. It is as vital to the economy as blood is to a person. Without gasoline and diesel fuel, the world as we know it would grind to a halt. The U.S. alone consumes about 130 billion gallons of gasoline per year!

This could get a little technical here, but we think it's important. Gasoline is known as an aliphatic hydrocarbon. In other words, gasoline is made up of molecules composed of nothing but hydrogen and carbon arranged in chains. Gasoline molecules have from seven to 11 carbons in each chain.

When you burn gasoline under ideal conditions – meaning with plenty of oxygen - you get carbon dioxide from the carbon atoms in gasoline, water from the hydrogen atoms, and lots of heat. A gallon of gasoline contains about 132×10^6 joules of energy, which is equivalent to 125,000 BTU or 36,650 watt-hours.

To illustrate this concept, consider the following:

- If you took a 1,500-watt space heater and left it on full blast for a full 24-hour day, that's about how much heat is in a gallon of gas.

- If it were possible for human beings to digest gasoline, a gallon would contain about 31,000 food calories -- the energy in a gallon of gasoline is equivalent to the energy in about 110 McDonald's hamburgers!

Now, stick with us through this next part! It can get a little confusing!

Gasoline is made from crude oil. The crude oil pumped out of the ground is black liquid called petroleum. This liquid contains hydrocarbons, and the carbon atoms in crude oil link together in chains of different lengths.

It turns out that hydrocarbon molecules of different lengths have different properties and behaviors. For example, a chain with just one carbon atom in it (CH4) is the lightest chain, known as methane. Methane is a gas so light that it floats like helium. As the chains get longer, they get heavier.

The first four chains -- CH4 (methane), C2H6 (ethane), C3H8 (propane) and C4H10 (butane) -- are all gases, and they boil at -161, -88, -46 and -1 degrees F, respectively, The chains up through C18H32 or so are all liquids at room temperature, and the chains above C19 are all solids – such as fats - at room temperature.

The different chain lengths have progressively higher boiling points, so they can be separated out by distillation. This is what happens in an oil refinery -- crude oil is heated and the different chains are pulled out by their vaporization temperatures.

The chains in the C5, C6 and C7 range are all very light, easily vaporized, clear liquids called naphthas. They are used as solvents. Cleaning products can be made from these liquids, as well as paint solvents and other quick-drying products.

The chains from C7H16 through C11H24 are blended together and used for gasoline. All of them vaporize at temperatures below the boiling point of water. That's why if you spill gasoline on the ground it evaporates very quickly.

Kerosene is in the C12 to C15 range followed by diesel fuel and heavier fuel oils like heating oil for houses.

Then there are lubricating oils. These oils no longer vaporize in any way at normal temperatures. For example, engine oil can run all day at 250 degrees F without vaporizing at all. Oils go from very light (like 3-in-1 oil) through various thicknesses of motor oil through very thick gear oils and then semi-solid greases. Vaseline falls in this category as well.

Chains above the C20 range form solids, starting with paraffin wax, then tar and finally asphaltic bitumen, which used to make asphalt roads.

All of these different substances come from crude oil. The only difference is the length of the carbon chains!

Almost all cars use four-stroke gasoline engines. One of the strokes is the compression stroke, where the engine compresses a cylinder-full of air and gas into a much smaller volume before igniting it with a spark plug. The amount of compression is called the compression ratio of the engine. A typical engine might have a compression ratio of 8-to-1.

The octane rating of gasoline tells you how much the fuel can be compressed before it spontaneously ignites. When gas ignites by compression rather than because of the spark from the spark plug, it causes knocking in the engine. Knocking can damage an engine, so it is not something you want to have happening. Lower-octane gas like regular unleaded 87-octane gasoline can handle the least amount of compression before igniting.

The compression ratio of your engine determines the octane rating of the gas you must use in the car. One way to increase the horsepower of an engine is to increase its compression ratio. So a "high-performance engine" has a higher compression ratio and requires higher-octane fuel such as premium.

The advantage of a high compression ratio is that it gives your engine a higher horsepower rating for a given engine weight -- that is what makes the engine "high performance." The disadvantage is that the gasoline for your engine costs more.

The name "octane" comes from when you take crude oil and "crack" it in a refinery, you end up getting hydrocarbon chains of different lengths. These different chain lengths can then be separated from each other and blended to form different fuels.

For example, methane, propane and butane are all hydrocarbons. Methane has a single carbon atom. Propane has three carbon atoms chained together. Butane has four carbon atoms chained together. Pentane has five, hexane has six, heptane has seven and octane has eight carbons chained together.

It turns out that heptane handles compression very poorly. Compress it just a little and it ignites spontaneously. Octane handles compression very well -- you can compress it a lot and nothing happens.

Eighty-seven-octane gasoline is gasoline that contains 87-percent octane and 13-percent heptane (or some other combination of fuels that has the same performance of the 87/13 combination of octane/heptane). It spontaneously ignites at a given compression level, and can only be used in engines that do not exceed that compression ratio.

During WWI, it was discovered that you can add a chemical called tetraethyl lead to gasoline and significantly improve its octane rating. Cheaper grades of gasoline could be made usable by adding this chemical. This led to the widespread use of "ethyl" or "leaded" gasoline. Unfortunately, the side effects of adding lead to gasoline are:

- Lead clogs a catalytic converter and renders it inoperable within minutes.

- The Earth became covered in a thin layer of lead, and lead is toxic to many living things including humans.

When lead was banned, gasoline got more expensive because refineries could not boost the octane ratings of cheaper grades any more. Airplanes are still allowed to use leaded gasoline, and octane ratings of 115 are commonly used in super-high-performance piston airplane engines. In case you were wondering, jet engines burn kerosene.

Another common additive is MTBE. MTBE is the acronym for methyl tertiary butyl ether, a fairly simple molecule that is created from methanol.

MTBE gets added to gasoline for two reasons:

1. It boosts octane

2. It is an oxygenate, meaning that it adds oxygen to the reaction when it burns. Ideally, an oxygenate reduces the amount of unburned hydrocarbons and carbon monoxide in the exhaust.

MTBE started getting added to gasoline in a big way after the Clean Air Act of 1990 went into effect. Gasoline can contain as much as 10 percent to 15 percent MTBE.

The main problem with MTBE is that it is thought to be carcinogenic and it mixes easily with water. If gasoline containing MTBE leaks from an underground tank at a gas station, it can get into groundwater and contaminate wells. Of course, MTBE isn't the only thing getting into the groundwater when a tank leaks -- gasoline and a host of other gasoline additives can also leak into water supplies.

The most likely thing to replace MTBE in gasoline is ethanol -- normal alcohol. It is somewhat more expensive than MTBE, but it is not a cancer threat.

Gasoline has two problems when burned in car engines. The first problem has to do with smog and ozone in big cities. The second problem has to do with carbon and greenhouse gases.

When cars burn gasoline, they would ideally burn it perfectly and create nothing but carbon dioxide and water in their exhaust. Unfortunately, the internal combustion engine is not perfect. In the process of burning the gasoline, it also produces:

- Carbon monoxide, a poisonous gas
- Nitrogen oxides, the main source of urban smog
- Unburned hydrocarbons, the main source of urban ozone

Catalytic converters eliminate much of this pollution, but they aren't perfect either. Air pollution from cars and power plants is a real problem in big cities.

Carbon is also a problem. When it burns, it turns into lots of carbon dioxide gas. Gasoline is mostly carbon by weight, so a gallon of gas might release 5 to 6 pounds of carbon into the atmosphere. The U.S. is releasing roughly 2 billion pounds of carbon into the atmosphere each day.

If it were solid carbon, it would be extremely noticeable -- it would be like throwing a 5-pound bag of sugar out the window of your car for every gallon of gas burned. But because the 5 pounds of carbon comes out as an invisible gas (carbon dioxide), most of us are oblivious to it.

The carbon dioxide coming out of every car's tailpipe is a greenhouse gas. The ultimate effects are unknown, but it is a strong possibility that, eventually, there will be dramatic climate changes that affect everyone on the planet - global warming to be exact. For this reason, there are growing efforts to replace gasoline with hydrogen and other alternative fuels.

There are many alternatives that are being explored to replace gasoline as fuel of choice, but many of us are still forced to use gasoline as our primary fuel. Let’s face it, these days, gasoline prices are absolutely ridiculous, but why?

Chapter 3 - Why Are Gas Prices So High?

(Return to Contents)

There are three main grades of gasoline: regular, mid-grade, and premium. Each grade has a different octane level. Price levels vary by grade, but the price differential between grades is generally constant.

The cost to produce and deliver gasoline to consumers includes the cost of crude oil to refiners, refinery processing costs, marketing and distribution costs, and finally the retail station costs and taxes. The prices paid by consumers at the pump reflect these costs, as well as the profits (and sometimes losses) of refiners, marketers, distributors, and retail station owners.

In 2005 the price of crude oil averaged $50.23 per barrel, and crude oil accounted for about 53 percent of the cost of a gallon of regular grade gasoline. In comparison, the average price for crude oil in 2004 was $36.98 per barrel, and it composed 47 percent of the cost of a gallon of regular gasoline. The share of the retail price of regular grade gasoline that crude oil costs represent varies somewhat over time and among regions.

Federal, State, and local taxes are a large component of the retail price of gasoline. Taxes (not including county and local taxes) account for approximately 19 percent of the cost of a gallon of gasoline. Within this national average, Federal excise taxes are 18.4 cents per gallon and State excise taxes average about 21 cents per gallon. Also, eleven States levy additional State sales and other taxes, some of which are applied to the Federal and State excise taxes.

Additional local county and city taxes can have a significant impact on the price of gasoline. Refining costs and profits comprise about 19 percent of the retail price of gasoline. This component varies from region to region due to the different formulations required in different parts of the country.

Distribution, marketing and retail dealer costs and profits combined make up 9 percent of the cost of a gallon of gasoline. From the refinery, most gasoline is shipped first by pipeline to terminals near consuming areas, and then loaded into trucks for delivery to individual stations.

Some retail outlets are owned and operated by refiners, while others are independent businesses that purchase gasoline for resale to the public. The price on the pump reflects both the retailer's purchase cost for the product and the other costs of operating the service station. It also reflects local market conditions and factors, such as the desirability of the location and the marketing strategy of the owner.

Because gasoline is made of crude oil, the biggest reason for the fluctuation in gas prices has to be the price of that crude oil. Essentially, crude oil prices are determined by supply and demand. However, world events can certainly affect the price of crude oil. The price on a barrel of oil rose sharply during the following world events:

- The Arab oil embargo in 1973
- The Iranian revolution in 1978
- The Iran/Iraq War in 1980
- The Persian Gulf Conflict in 1990
- The Iraq War currently being fought today

The turmoil occurring in these countries during these difficult times certainly affected production of oil and thus affected oil prices as well.

Believe it or not, even environmental and weather problems can affect gas prices. When Hurricane Katrina hit in 2005, some crucial oil refineries located in the region were devastated. That meant that oil had to be refined elsewhere and

then transported. This increased fuel costs with the distance involved during this process.

Finally, that old-fashioned concept of business competition can also affect gas prices, although, in many cases, that can actually help the consumer. With so many gas stations, every single one wants their share of the business that is out there. If there are stations that are located close to each other, most will lower their prices, even by a cent or two just to get the consumer to come to them.

On the other hand, if you have a gas station that is the only one around for a few miles, they know that they have the consumer between a rock and a hard place. That's why their prices tend to be higher than those in town.

So now that you know everything you need to know about gasoline and oil, now let's look at how alternative fuels are affecting the gasoline market. First, we need to address the fact that not all cars can run on alternative fuels.

Chapter 4 - Alternative Fuel Vehicle (AFV)

(Return to Contents)

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 2006, 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.

Most incentives offset a percentage of the incremental cost of the vehicle (the additional dollars OEMs charge for the AFV versus a conventional model). Federal and state laws also help keep the cost of alternative fuels competitive with gasoline or diesel.

Consider the following examples of state offered incentives:

- In California, AFVs can use the High Occupancy Vehicle lane regardless of the number of passengers in the car. Plus, in some places, AFVs even get free metered parking.

- Texas is giving schools and school districts grants to convert school vehicles such as buses to an AFV. The state also provides a tax break during licensing and registration for the owner of an AFV.

- Florida also offers an exemption to the driver of an AFV allowing them to travel in the High Occupancy Vehicle lane regardless of how many passengers are in the car. They are also exempt from a portion of taxes levied on fuel.

- When people who have AFVs and go to fuel them at approved fueling stations, they are exempt from all state and local excise and use taxes placed on the fuel.

And that's just a sampling. Almost all states have federal grants and funding specifically allocated to make a switch for all government vehicles including heavy equipment, buses, and taxis to become alternative fuel vehicles. States are increasingly aware of the damage that car emissions can cause and they are taking steps to make their states environmentally friendly and healthier.

So we know that owning an AFV is a good decision both ecologically as well as financially from a fuel standpoint. But what do these vehicles cost you? Well, you will be paying more for an AFV than for a regular gasoline powered car. Consider the following table:

Vehicle	AFV Option	Regular Option
Ford Escape	$23,320	$18,145
Lexus GS 450h	$55,615	$46,279
Chevrolet Silverado	$25,525	$12,268
Honda Accord	$31,685	$18,210

Of course, prices will vary according to your location, but you can see that, in general an AFV will cost you more up front than a gasoline powered car. However, you could also be saving a lot of money on your fuel and helping keep the environment clean and the world thriving for a longer time.

You can also convert a regular gasoline powered car to an AFV. A converted vehicle is one that was built to operate on gasoline or diesel but is modified to run on alternative fuels, such as compressed natural gas or propane the two most common types of fuel conversions.

The Environmental Protection Agency has very specific criteria as to how a car must be converted to an AFV. All vehicle conversions must be certified according to Mobile Source Enforcement Memorandum 1A (Memo 1A), the Addendum to Memo 1A, and the Revision to the Addendum to Memo 1A, which were issued by EPA.

A dedicated converted vehicle is one that operates only on an alternative fuel or a dual fuel which means that they can operate on either an alternative fuel or

gasoline. These types of vehicles have separate tanks and fuel systems for each fuel.

Bi-fuel vehicles are those designed to run on combinations of an alternative fuel along with a conventional fuel like gasoline. Dual fuel systems allow the use of only one fuel at a time, but bi-fuel systems supply both fuels into the combustion chamber tat the same time.

The Environmental Protection Agency certifies converted vehicles rather than the conversion systems or conversion kits. The EPA refers to a fuels converter as a small volume manufacturer that holds the certificate to perform a conversion. An individual who wants to have a vehicle converted to run on an alternative must do so through a company associated with a certificate holder.

The companies or organizations that would hold Certificates of Conformity issued by the EPA would include the designer of the conversion equipment, the producer or manufacturers of the equipment and the person who plans to perform the installations.

It is the responsibility of the certificate holder to insure that the equipment is properly installed and that the system is safe, durable, and results in the vehicle meeting the emission standards of the original model year of the vehicle.

Converting a gas-powered vehicle to an AFV is not an easy process, so unless you are an experienced mechanic, you should leave the conversion up to professionals. Conversion involves changing the fuel cells, the gas tank, hoses, and such. The cost will vary, but expect to pay somewhere around $4,000 to $6,000.

There are some incentives that states are offering consumers for conversions. Many mechanics who do conversions will probably know about specific grants for

this, but you can also check with your state or local government's website to see what types of incentives are offered.

As we've said, running a car on an alternative fuel could save you money in the long run on your fuel costs. Let's take a more in-depth look at alternative fuels and how they will help you as well as our world.

Chapter 5 - All About Alternative Fuels

(Return to Contents)

The innovations in alternative fuels are nothing short of amazing. Scientists have made amazing strides in this area even developing engines that can run on simple, everyday vegetable oil! I, personally, think that's absolutely amazing!

But there are a lot of other alternative fuels available and there are certain vehicles that are able to run on those fuels. We'll take a look at some of these fuels and how they are derived.

Ethanol

Ethanol is a type of alcohol that has been converted to allow it to become a source of fuel for vehicles. Ethanol is sometimes called grain alcohol and is generally made in the United States from corn. It can also be made from organic materials including agricultural crops and waste, plant material left from logging, and trash including paper.

Brazil, which is by far the largest producer in the world, makes ethanol from sugar cane. Projects are now underway in California to convert some of the state's agricultural waste, like rice straw that is now burned in fields, into ethanol.

The alcohol found in alcoholic beverages is ethanol. However, the ethanol used for motor fuel is denatured, which means poison has been added so people can't drink it.

Some people believe that ethanol takes more energy than it gives back and for the most part, this is true. However, technologies have evolved in such a way that it is possible to increase the efficiency of producing ethanol.

Corn ethanol today is made by converting the starch in corn to sugars and then into alcohol in a process of fermenting. A company in Canada, Iogen, has invented a process for converting agricultural waste such as corn stalks, husks, etc. (corn "stover") and other cellulose rich plant waste like straw into ethanol by using enzymes.

This process may raise the energy balance of ethanol to as high as 1:7, although there are no details related to a study of the effectiveness of this process. If waste agricultural products are used, then the energy for planting and harvesting have already been taken into account, allowing ethanol from waste to have a very favorable energy balance. It is estimated that as much as a third of the waste from our fields could be made into ethanol without harming the soil.

Corn ethanol yields about 300 gallons of ethanol per acre and corn is a fairly "high input" crop. That means that corn requires heavy fertilizers which hurts the energy balance equation.

The ethanol we get from corn is a result of converting the starch in corn into sugars and then into alcohol in a process of fermenting. Sweet sorghum starts with a high concentration of sweet juice in the plant.

A farmer in Iowa has invented a new process to harvest the sweet sorghum, crush the juice out while harvesting and add yeast during harvesting starting the fermenting process immediately. The sweet juice is then stored on the farm in a very large rubber bladder for a week to 10 days and, you've got hydrated ethanol (ethanol with about 8% water). Sweet sorghum produces about 900 gallons of ethanol per acre and is a lower input crop than corn.

During the energy crisis of the 70s and 80s, there was a product referred to as "Gasohol" that was about 10% ethanol or "E10". Gasoline engines needed minor

modifications to run on E10 because the ethanol tended to degrade seals and fuel hoses.

Modern gasoline engines are now set up to run E10. In Iowa, about 60% of the gasoline sold is E10. It is actually the least expensive gasoline grade because the ethanol is subsidized to make it so.

To use higher percentages like E85, engines need appropriate seals, hoses and engine settings like timing, etc.. Vehicles set up to run E85 have been selling for a number of years and are sold as "Flex Fuel" vehicles (FFV). Such vehicles have a fuel sensor in the fuel line to monitor the mix of gasoline and ethanol present and adjust the engine appropriately for the fuel being used.

Either all gasoline can be used or any mixture of ethanol up to 85% ethanol (E85). The stimulus for these vehicles being available was the 1992 EPAct that mandated that government vehicle fleets use renewable fuels. Many such vehicles have been purchased by government fleets and then sold later as used vehicles to individuals. There are people that have FFVs and are not even aware they can run E85.

You can generally tell if you have an FFV by looking at the engine and seeing if there is a sticker or some other indicator that you have an FFV car. You'd be surprised at how many vehicles are capable of running E85 fuel, so check it out – it could save you some money!

Compared with gasoline-fueled vehicles, most ethanol-fueled vehicles produce lower carbon monoxide and carbon dioxide emissions and the same or lower levels of hydrocarbon and non-methane hydrocarbon emissions. Oxides of nitrogen emissions are about the same for ethanol and gasoline vehicles. E85 has fewer highly volatile components than gasoline and so has fewer evaporative emissions.

Ethanol has a high octane rating (108 +), which is beneficial in engines that are designed to operate on higher octane fuels. However, because ethanol is blended with gasoline in E85 the actual octane level rating will vary by season and location. Unlike gasoline, the octane rating of E85 is rarely posted on the pump and doing so is not required by law.

Methanol

Methanol is Ethanol's cousin in a way as they are both alcohol based products. 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 also very poisonous and very harmful if swallowed. Methanol must not be confused with ethanol. As with gasoline, it is also wise to avoid skin contact with methanol, as it can pass through the skin. Methanol is also used as an anti-freeze as well as a solvent.

As an interesting bit of history, the ancient Egyptians used methanol in their embalming process. When mummies were prepared for entombment, their blood was removed and replaced with methanol.

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. Problems occurred early in the development of gasoline-methanol blends, however. As a result of its low price, some gasoline marketers over-blended the mix. Others used improper blending and handling techniques.

This led to consumer and media problems. However, there is still a great deal of interest in using methanol as a neat fuel. The flexible-fuel vehicles currently

being manufactured by General Motors, Ford, and Chrysler can run on any combination of ethanol, methanol, and/or gasoline.

Methanol is used a lot in the open wheel racing circuits because it is highly combustible. It is also used a lot in drag racing as well as with remote control airplanes and on the Indy racing circuit. Methanol is less flammable than gasoline so it is considered safer to use in high performance engines.

Scientists are working toward a more methanol based fuel for consumer use and because it is cheaper to process, the likelihood that it will be cheaper to the user is much greater as well.

Compressed Natural Gas

You can cook with it and heat your house with it. You may even power a car or truck with it. So what is it? It's natural gas. Like oil, this common fuel comes from underground. However, natural gas, as the name implies, is a gas much like air, rather than a liquid like petroleum. It has been found to be one of the most environmentally friendly fuels, and its popularity is growing.

Natural gas, like methanol, is mostly made up of methane gas – 95 percent. The other 5 percent is made up of various gases along with small amounts of water vapor. These other gases include butane, propane, ethane and other trace gases. Methane is a hydrocarbon, meaning its molecules are made up of hydrogen and carbon atoms. Its simple, one carbon, molecular structure (CH4) makes possible its nearly complete combustion.

Because of its clean burning nature and the fact that it is not made from petroleum, as gasoline and diesel are, many automakers around the world are developing vehicles to run on natural gas. Cars, vans, buses and small trucks

generally use natural gas that has been compressed and stored in high-pressure cylinders.

Several vehicles are available today such as the Honda Civic CGX and the Ford Crown Victoria that operate on compressed natural gas. Some run on natural gas only and others can run on natural gas or gasoline in bi-fuel vehicles. You may have better luck converting your vehicle to run on natural gas rather than trying to find a car that runs on it anyway.

Dedicated natural gas vehicles (NGVs) are designed to run only on natural gas; bi-fuel NGVs have two separate fueling systems that enable the vehicle to use either natural gas or a conventional fuel.

In general, dedicated NGVs demonstrate better performance and have lower emissions than bi-fuel vehicles because their engines are optimized to run on natural gas. In addition, the vehicle does not have to carry two types of fuel, thereby increasing cargo capacity and reducing weight.

Compressed natural gas certainly is the newest and most popular change in alternative fuels. It has the most promise as a viable alternative to gasoline and it certainly is much better for the environment.

Fueling stations are available in many larger cities and even in rural areas. You can easily locate a fueling station by asking around or doing a quick Internet web search.

Natural gas vehicles are just as safe as today's conventional gasoline and diesel vehicles. They use pressurized tanks, which have been designed to withstand severe impact, high external temperatures, and environmental exposure. Adequate training is required to operate and maintain natural gas vehicles

because they are different than gasoline or diesel vehicles. Training and certification of service technicians is required.

In general, a natural gas vehicle can be less expensive to operate than a comparable conventionally fueled vehicle depending on natural gas prices. Natural gas can cost less than gasoline and diesel per energy equivalent gallon; however, local utility rates can vary.

Purchase prices for natural gas vehicles are somewhat higher than for similar conventional vehicles. The auto manufacturers' typical price premium for a light-duty CNG vehicle can be $1,500 to $6,000. For heavy-duty trucks and buses it is in the range of $30,000 to $50,000.

Federal and other incentives can help defray some of the increase in vehicle acquisition costs. In addition, fleets may need to purchase service and diagnostic equipment if access to commercial CNG/LNG vehicle maintenance facilities is not available. Learn more about NGV tax incentives.

Retrofitting a conventional vehicle so it can run on CNG may cost $2,000 to $4,000 per vehicle. However, the price may be well worth it in the long run – especially for the environment. Processing procedures as well as increased availability could conceivably bring the price of CNG lower than conventional gasoline.

High-pressure tanks that hold CNG require periodic inspection and certification by a licensed inspector. Some natural gas vehicle manufacturers now recommend oil changes at intervals twice as long as similar gasoline or diesel models (10,000-12,000 miles).

Compared with vehicles fueled by conventional diesel and gasoline, NGVs can produce significantly lower amounts of harmful emissions such as nitrogen

oxides, particulate matter, and toxic and carcinogenic pollutants. NGVs can also reduce emissions of carbon dioxide, the primary greenhouse gas.

The cost of a gasoline-gallon equivalent of CNG can be favorable compared to that of gasoline, but varies depending on local natural gas prices. As we've already said, there will continue to be advancements made in this arena which could be significant for the consumer.

Natural gas is mostly domestically produced. In 2004, net imports of natural gas were approximately 15% of the total used, with almost all the imports coming from Canada.

Some natural gas vehicle owners report service lives 2 to 3 years longer than gasoline or diesel vehicles and extended time between required maintenance.

Electricity

Believe it or not, electric vehicles have been around for a very long time. In the early 1900s, there were more electric vehicles than there were gasoline-powered cars. Back in the early 1920's when vehicles were becoming more popular, gasoline was very expensive.

It also was hard to start a gasoline engine; you had to turn and turn and turn a crank in front of the car to get it to start. They did not have a key to start the car like we do today. Gasoline vehicles were also noisy and put out lots of smoke. The cars either had no mufflers, or the mufflers didn't do a good job. So, electric vehicles were a big hit. At one time there were 50,000 of them on the roads and streets of the United States.

But these vehicles soon faded away like the horse-drawn carriage. New ways to make gasoline cheaply were being discovered. A new invention called an electric

starter was made. It started the car with a key instead of a crank. A gasoline car could go much farther than an electric one. So, gasoline-powered vehicles soon became the main method of transporting people.

Automobile companies are making cars cleaner and cleaner today. Ten cars built today produce the same amount of pollution that you'd get from just one car built 15 years ago. And oil companies are creating cleaner fuels like a new gasoline called reformulated gasoline. But electric vehicles are once again back on the road.

Electric vehicles don't burn gasoline in an engine. They use electricity stored on the car in batteries. Sometimes, 12 or 24 batteries, or more, are needed to power the car. Just like a remote-controlled, model electric car, EVs have an electric motor that turns the wheels and a battery to run that motor.

One of the first modern EVs was the General Motors Impact. GM changed its name and started selling the GM "EV1" in 1997. This sleek looking car even set a World Record of more than 180 miles per hour!

The EV1 is very aerodynamic. This means that air slides around the body of the car very easily. The less air resistance or drag, the less energy is needed to power the car at freeway speeds. In face, the EV1 is as aerodynamic as some jet fighter aircrafts! However, the GM Impact is not yet available for sale.

To charge an EV's batteries, the car is usually plugged in at night. Some EVs can plug right into a regular electrical wall outlet. Others need a larger outlet, like the kind that a stove or electric clothes dryer plug into. Electricity, is then stored in the batteries of the EV.

The batteries can be lead acid batteries, like the batteries you find in our flashlight or in regular gasoline cars. Or they can be ni-cad (nickel-cadmium) like

the kind that run portable video recorders or a portable video game player -- only much larger.

Better batteries that hold more energy and last longer are being developed. In 2001, by the time today's fifth graders are ready to drive, electric vehicles should be able to travel 150 to 200 miles before recharging.

Most EVs today, however, can only go about 100 miles before you need to plug them in and recharge their batteries. They are not like the Energizer Bunny that keeps on going, and going, and going. But, 50 to 100 miles is plenty for most people who only drive a short distance to and from work, to and from school, or to do some shopping.

Electric vehicles are more expensive to buy than gasoline cars, but when more and more EVs are made, the price of EVs should drop to about the same as gasoline cars.

Some EVs, like the Toyota RAV-4 EV are made by major auto companies. Other electric vehicles built today are made by small car companies, or by people who build them in their own garages as a hobby. Some people build cars from kits and make them look like gasoline roadsters or like sports cars.

Other people convert regular cars into electric vehicles. They pull out the motor and gas tank and put an electric motor and batteries into the car. Sometimes, the batteries go into the trunk or even under the back seat...they go where ever there is room.

Beginning in 1999, nearly all of the major auto companies -- Ford, General Motors, Toyota, Chrysler and Honda offered at least one model electric car. That numbers has dropped in 2002, with many auto companies working on hybrid

vehicles -- a combination of a small internal combustion engine and an electric motor.

Another type of electric vehicle is a golf cart or neighborhood watch vehicle. These battery powered electric vehicles are used to patrol in small, private neighborhoods, travel around the golf course, or provide small distance transportation in various situation.

Solar Power

A solar powered vehicle is an electric vehicle powered by solar energy obtained by solar panels that are on the surface of the car. Photovoltaic (PV) cells convert the sun's energy directly into electrical energy.

Solar cars are not practical day-to-day transportation devices at present, but are primarily demonstration vehicles and engineering exercises. Solar cars compete in races (often called rayces) such as the World Solar Challenge and the American Solar Challenge. These events are often sponsored by government agencies, such as the United States Department of Energy, who are keen to promote the development of alternative energy technology such as solar cells.

Such challenges are often entered by universities to develop their students' engineering and technological skills, but many professional teams have entered competitions as well, including teams from GM and Honda.
The electrical system is the most important part of the solar car's systems as it controls all of the power that comes into and leaves the system. The battery pack plays the same role in a solar car that a gas tank plays in a normal car in storing power for future use.

Solar cars achieve their performance by extreme lightness of weight along with very efficient aerodynamics. Those simple concepts would require unacceptable

compromises that would not really be feasible for a day-to-day transportation device.

Conventional vehicles today are built for passenger comfort, among other considerations making the ultra-compact nature of a solar car impractical for the everyday consumer. Meeting contemporary safety standards would make a solar car much less aerodynamic and heavier which would require more power to achieve standard highway speeds. With current and foreseeable technologies, it is unlikely a completely solar car will become commercially available.

However, solar cars are basically electric cars with an inbuilt recharging capability, so when you take engineering knowledge and pair it with technology develop in competition solar cars that may help the development of battery electric vehicles and even hybrid vehicles.

Still, there is a question as to whether if battery electric vehicles become popular, it will be worthwhile fitting them with solar cells to extend their range and allowing them to recharge while parked anywhere in the sun. While a solar powered vehicle would be a no emission vehicle and great for the environment, having one become an everyday use vehicle is probably not going to happen.

But, one very practical application for a solar powered vehicle could lie within the golf cart industry. While many golf carts are electrically powered, there are still many that run on gas thus releasing the same greenhouse gases that come from cars.

Golf carts aren't used for hours on end – except by my husband – and they spend most of their time parked in the sun. Besides saving on electricity – which is getting more and more expensive every day – they can also reduce gas emissions completely. At least it's a start!

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.

Anyone who has taken a chemistry class knows that hydrogen is number one on the periodic chart of elements and the lightest of all elements. It is easy to produce through electrolysis, simply splitting water (H20) into oxygen and hydrogen by using electricity. However, these days, nearly all hydrogen is made from natural gas.

Because hydrogen burns nearly pollution-free, it has been looked at as the ultimate clean fuel. When burned, it turns into heat and water vapor. When burned in an internal combustion engine (the kind of engine in gasoline cars today), the combustion also produces small amounts of other gases.

These other gases are mostly oxides of nitrogen because the hydrogen is being burned with air, which is about two-thirds nitrogen. Being a non-carbon fuel, the exhaust is free of carbon dioxide. Carbon dioxide, emitted from our burning of fossil fuels, is causing the world's climate to change.

Hydrogen is normally a gas and can be compressed and stored in cylinders. The main problem with hydrogen is bulk of the cylinders or fuel tanks. Compressed hydrogen contains less energy per volume compared to liquid fuels like gasoline or ethanol. Hydrogen can also be cooled to produce liquid hydrogen, but it is costly.

Hydrogen's clean burning characteristics may, one day, make it a popular transportation fuel. For now, the problem of how to store enough hydrogen on a vehicle for a reasonable range, and its high cost, compared to gasoline, are critical barriers to widespread commercial use. Nearly all hydrogen currently is

made from natural gas. For that reason, hydrogen usually costs more than natural gas.

There have only been a small number of prototype hydrogen vehicles made. Most of these have been experimental vehicles made by car manufacturers. Nearly all of these prototype cars were equipped with internal combustion engines, similar to ones that run on gasoline.

Hydrogen is also used in fuel cells which are used to power fuel cell vehicles. Fuel cell vehicles are the most promising vehicles in saving the environment as they are considered zero-emission vehicles. Fuel cells have been used on spacecraft for many years to power electric equipment. These are fueled with liquid hydrogen from the spacecraft's rocket fuel tanks.

Fuel cell vehicles turn hydrogen fuel and oxygen into electricity. The electricity then powers an electric motor, just like electricity from batteries powers the motor of an electric vehicle. Fuel cells combine oxygen from the air with hydrogen from the vehicle's fuel tank to produce electricity. When oxygen and hydrogen are combined they give off energy and water (H2O). In fuel cells this is done without any burning (combustion).

When we think of vehicles that are fueled with hydrogen, we may think of rocket-powered spacecraft, like the space shuttle. The space shuttle is fueled with liquid oxygen and liquid hydrogen. To fly, the oxygen and hydrogen are mixed together and ignited to make a very hot fire.

The expanding gases from that fire are what propel the spacecraft. The exhaust from spacecraft rocket motors (and hydrogen-fueled fuel cells) is mostly water. That is why hydrogen-fueled fuel cell vehicles. Very little is in the exhaust except water. Fuel cells do get hot though, so the water comes out of the fuel cells as water vapor, or steam.

There are a number of ways that hydrogen can be provided to the fuel cell. One way is simply to put hydrogen gas into the fuel cell, along with air. Hydrogen gas can come from gaseous or liquid hydrogen stored on the vehicle.

To carry gaseous hydrogen on a vehicle, it must be compressed. When compressed (usually to a pressure of about 3000 pounds per square inch), it must be stored in special high-pressure containers. This is similar to the way compressed natural gas is stored on natural gas-fueled vehicles.

The other way to provide hydrogen gas to the fuel cell is to store it on the vehicle in liquid form. To make hydrogen liquid, it is chilled and compressed. Liquid hydrogen is very, very cold--more than 423.2 degrees Fahrenheit below zero!

This super-cold liquid hydrogen is the kind used in space rockets. The containers are able to hold pressure, but they are also insulated to keep the liquid hydrogen from warming up. Warming the liquid, or lowering the pressure, releases gas (like boiling water), and the gas can go to the fuel cell.

Another way to get hydrogen to the fuel cell is to use a "reformer". A reformer is a device that removes the hydrogen from hydrocarbon fuels, like methanol or gasoline. When a fuel other than hydrogen is used, the fuel cell is no longer zero-emission, but it still may be very low emitting.

There is also a type of fuel cell that can be fueled with methanol directly. This is called a direct-methanol fuel cell. This type of fuel cell does not need a reformer to separate the hydrogen from the methanol. The fuel cell removes the hydrogen from the liquid methanol inside the fuel cell.

Many people in the vehicle manufacturing business think that fuel cell vehicles may be the technology of the future. However, a lot of work will have to be done

to make fuel cell vehicles perform well enough to replace the internal combustion engine in the vehicles we use today. They also will need to be made much less expensive.

At present, fuel cell vehicles have only been developed to what might be called the pre-prototype stage. That means there are very few fuel cell vehicles in existence, and all of them are actually used for testing.

Most car manufacturers have or are working on demonstration models, some of which can reach a speed of 90 mph and can travel up to about 280 miles before they need refueling. Some manufacturers claim they will have fuel cell cars available for the public in the next ten years.

Liquefied Natural Gas

Natural gas can be made into three forms. One kind is the low-pressure form you use to cook or heat your home. It comes from the underground pipe from the gas company.

Another form is compressed natural gas (CNG). This form is compressed into high-pressure fuel cylinders to power a car or truck. It comes from special CNG fuel stations.

The third form is liquefied natural gas (LNG). LNG is made by refrigerating natural gas to condense it into a liquid. The liquid form is much denser than natural gas or CNG. It has much more energy for the amount of space it takes up. So, much more energy can be stored in the same amount of space on a car or truck. That means LNG is good for large trucks that need to go a long distance before they stop for more fuel.

Liquefied natural gas is made by refrigerating natural gas to minus 260 degrees Fahrenheit (260 degrees below zero!) to condense it into a liquid. This is called liquefaction. The liquefaction process removes most of the water vapor, butane, propane, and other trace gases, that are usually included in ordinary natural gas.

The resulting LNG is usually more than 98 percent pure methane. Caterpillar, Cummins, Detroit Diesel, Mack and Navistar all sell heavy-duty natural gas engines that can operate on LNG.

Even though liquefied natural gas produces less pollution, it is not used in widespread form because it is expensive to produce plus it must be transported in cryogenic tanks which are also extremely expensive. However, liquefied natural gas plants are being constructed all over the world and steps are being taken to try and curtail the expense of producing this alternative fuel.

Liquefied Petroleum Gas

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").

Propane has been used in vehicles since the 1920s. Today there are more than 200,000 propane vehicles in the United States and about 9 million worldwide. These include cars, pickup trucks, and vans; and medium- heavy-duty vehicles

such as shuttles, trolleys, delivery trucks, and school buses; and off-road vehicles such as forklifts and loaders.

Propane vehicles can be equipped with dedicated fueling systems designed to use only propane, or bi-fuel fueling systems that enable fueling with either propane or gasoline.

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.

The LPG used in vehicles is the same as that used in gas barbecues and camper appliances. LPG is also used in many homes in the country, where there are no natural gas pipelines. These homes use LPG for heating, cooking, hot water and other energy needs.

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. In the Netherlands over 10 percent of the motor fuel used is LPG.

Propane vehicles can produce 60% fewer ozone-forming emissions (CO and NOx) 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.

The cost of a gasoline-gallon equivalent of LPG is generally less than that of gasoline, but varies depending on location.

Biodiesel

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.

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 fuel.

Ordinary diesel engines can run on biodiesel. 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.

Soybeans are used to make tofu and soy sauce. Soybean and rapeseed oil have been tried as biodiesel because they are less expensive than most other types of vegetable oil.

Although soybean and rapeseed oil are more expensive than regular diesel fuel, most other types of vegetable oils are too expensive to even be considered for use as diesel fuel. Animal fat also is too expensive for this use, but used oil from restaurants has been tried for biodiesel with great success.

Consider the following story:

Tom McGurr, a New Jersey contractor, has found a new way to beat the high cost of diesel--by scrounging used vegetable oil from fast-food restaurants, which are usually happy to give it away. But McGurr doesn't just pour fry oil into his tank. Using a kit from Missouri-based Greasel Conversions, McGurr filters the cooking oil into a tank in the truck bed.

Water from the engine's cooling system then heats the viscous oil before it's pumped into the engine. "I've put about 4000 miles on the conversion, and the truck runs great," McGurr says. "My commute is about 35 miles each way, and after only a few miles I can switch from regular diesel to the heated veggie oil, even on cold days."

A few miles from the end of the day's driving McGurr switches back to diesel. He does this to flush out the lines so oil doesn't congeal in the fuel-injection system. Charlie Anderson, owner of Greasel Conversions, has sold over 4500 of the kits to date; they cost $800 and up.

Biodiesel has been shown to produce lower tailpipe emissions than regular diesel fuel. The best thing about biodiesel is that it is made from plants and animals, which are renewable resources.

Biodiesel blends can be used in any light- or heavy-duty diesel engine. However, it is important to check with your manufacturer before using biodiesel. As with any fuel, an engine component failure caused by the fuel may not be covered under warranty.

Blends of biodiesel are being used in a number of heavy-duty vehicles throughout the country as well. The most common blend of biodiesel is B20 (20% biodiesel / 80% diesel), but B100 (neat biodiesel) and blends of less than 20% biodiesel can also be used.

Vehicles that have successfully used biodiesel include school and transit buses, refuse haulers, military support vehicles, farm equipment, and national park maintenance vehicles. Biodiesel fueling of light-duty diesel vehicles is less common. It is important to always consult your vehicle manufacturer to make sure they approve the use of biodiesel in their products.

Fleets looking to comply with the Energy Policy Act of 1992 (EPAct) must use fuel blends that contain at least 20% biodiesel.

According to the National Biodiesel Board, using a B20 biodiesel fuel blend can reduce vehicle emissions as follows:

- Unburned hydrocarbons - 20% reduction
- Carbon monoxide - 12% reduction
- Particulate matter - 12% reduction

Biodiesel is domestically produced, so its use helps reduce the nation's dependence on imported oil and can help boost the agricultural sector of the economy. It is also a renewable fuel made from domestically grown crops like soybeans and mustard seed. Biodiesel can also be produced from recycled cooking grease. When using biodiesel, lubricity is improved over conventional diesel fuel.

So, as you can see, there are many alternative fuels that can be used in vehicles as opposed to gasoline. But why should you use alternative fuels? Mainly because it helps the environment.

Chapter 6 - Environment Damage

(Return to Contents)

It took over 200 million years for the oil beneath the earth's surface to form. In the past 200 years, we have already used half of that reserve. If current rates of consumption continue, the world's remaining oil would be used up in 40 years.

Right now, two-thirds of the oil used around the world powers transportation vehicles, and half goes to passenger cars and light trucks. Being conscious of our fuel use will help to conserve resources for future generations.

Transportation involves the combustion of fossil fuels to produce energy translated into motion. Pollution is created from incomplete carbon reactions, unburned hydrocarbons or other elements present in the fuel or air during combustion.

These processes produce pollutants of various species, including carbon monoxide, soot, various gaseous and liquid vapor hydrocarbons, oxides of sulphur and nitrogen, sulphate and nitrate particulates, ash and lead.

These primary pollutants can, in turn, react in the atmosphere to form ozone, secondary particulates, and other damaging secondary pollutants. Combustion also produces carbon dioxide, the primary greenhouse gas.

These environmental concerns about the country's transportation habits have been studied extensively. The tailpipe emissions from cars and trucks account for almost a third of the air pollution in the United States.

Although smog is produced by many factors, including sunlight, temperatures, winds and "basin" effects the air pollution caused by transportation is a major contributor. In their Sprawl Report 2001, the Sierra Club graded the car and truck smog in America's 50 largest cities using data from the EPA.

The area containing New York City scored best, believe it or not, with a grade of C+, creating 54 pounds of smog from cars and trucks per person per year. Twelve of the top 50 cities earned a grade of F, including, surprisingly, Louisville, Kentucky, which has 137 pounds of smog from cars and trucks per person per year.

The Clean Air Act of 1970 gave the U.S. Environmental Protection Agency broad authority to regulate motor vehicle pollution, and since then, emission control policies have become progressively more stringent. In addition, the EPA has published various fact sheets, such as "Your Car and Clean Air: What YOU Can Do to Reduce Pollution."

The EPA advocates some easy changes to transportation habits such as:

- Avoiding unnecessary driving by consolidating trips, telecommuting, carpooling, using public transit, and choosing clean transportation alternatives such as biking and walking.

- Maintaining your car properly, something that will not only reduce the car's emissions and enhance its performance but will extend its life, increase its resale value, and optimize its fuel economy.

- Driving your car wisely; whenever possible, avoid things like idling, stop-and-go driving, air conditioning, high engine loads, idling in cold temperatures, and spilling or overfilling when refueling.

- Exploring the use of alternative fuels instead of conventional gasoline

In many urban areas, motor vehicles are the single largest contributor to ground-level ozone, a major component of smog. Ground-level ozone is the most serious air pollution problem in the northeast and mid-Atlantic states.

Cars also emit several pollutants classified as toxics, which cause as many as 1,500 cases of cancer in the country each year. Auto emissions also contribute to the environmental problems of acid rain and global warning.

Pollution control measures have drastically reduced emissions per vehicle in the past 20 years. However, during that time the total miles traveled has doubled, resulting in higher levels of air pollutants in many parts of the country.

As we touched on before, motor vehicles generate three major pollutants: hydrocarbons, nitrogen oxides, and carbon monoxide.

- Hydrocarbons react with nitrogen oxides in the presence of sunlight and elevated temperatures to form ground-level ozone. It can cause eye irritation, coughing, wheezing, and shortness of breath and can lead to permanent lung damage.

- Nitrogen oxides (NO) also contribute to the formation of ozone and contribute to the formation of acid rain and to water quality problems.

- Carbon monoxide is a colorless, odorless, deadly gas. It reduces the flow of oxygen in the bloodstream and can impair mental functions and visual perception. In urban areas, motor vehicles are responsible for as much as 90 percent of carbon monoxide in the air.

Motor vehicles also emit large amounts of carbon dioxide, which has potential to trap the Earth's heat and cause global warning which we'll address in the next section.

Cars release pollutants from the tailpipe as the result of the fuel combustion process, and from under the hood and throughout the fuel system when heat causes fuel evaporation. Evaporative emissions occur at these times:

- When outside temperatures on hot, sunny days cause a car's fuel to evaporate
- When the hot engine and exhaust system of a running car cause the fuel to become heated
- When the car is shut off and remains hot enough to cause fuel to evaporate
- During refueling, when gasoline vapors escape into the air from the gas tank and the nozzle

The greatest amount of tailpipe pollutants are released during the "cold start" phase, or the first few minutes it takes a car to warm up. Since a car warms up faster when it is moving, drivers are advised to limit warm-up time. Combining trips also decreases motor vehicle emissions since it reduces the number of cold starts.

Environmental damage caused by car emissions is a problem – there's no doubt about that. But there is another very serious issue that comes from car emissions due to gasoline usage.

Chapter 7 - Global Warming

(Return to Contents)

Former Vice President of the United States, Al Gore, has brought the issue of global warming to the forefront of people's minds with his Oscar winning documentary, "An Inconvenient Truth." While there are some people who have been concerned about global warming for years, but this movie helped make the phenomenon more "famous" if you will.

If you've never thought about global warming, consider the following facts:

- Since the 1970's, there has been a 100 percent increase in the intensity and duration of hurricanes and tropical storms.

- According to the U.S. Geological Survey predictions, by the year 2030, Glacier National Park will have no glaciers left at all.

- 400,000 square miles of the Arctic Sea have melted in the last thirty years. That is roughly the size of Texas and is threatening polar bear habitats.

- By the year 2050, 15 to 17 percent of animal and plant species will be wiped out by global warming

- The United States is the number one global warming polluter in the world.

- Six former United States Environmental Protection Agency leaders say that the U.S. isn't doing enough to reduce pollution that contributes to global warming. This is supported by the fact that the United States Congress has not passed one piece of legislation related to the reduction of global warming.

Basically, global warming is an observable progressive warming of the average temperature of the Earth over a period of time. While some people might think is a great thing envisioning mild winters, but the truth is that global warming is a disturbing phenomenon.

The rising temperatures can cause changes like rising sea levels, an increase in the frequency and intensity of severe weather, decreased agricultural yields, and glacial retreats and/or disappearances. Global warming is also projected to cause the eventual extinction of many plant and animal species as they struggle to survive in warmer climates that they aren't used to.

Global warming is caused mostly by the release of methane gas into the environment. Methane is a greenhouse gas that traps heat in the Earth's atmosphere. Methane gas is naturally released from arctic tundra and wetlands.

However, the biggest contributing factors toward global warming are man-made. Man-made causes bring about the most damage when considering the global warming trend.

Pollution is one of the biggest man-made problems. Pollution comes in many shapes and sizes. Burning fossil fuels is one thing that causes pollution. Fossil fuels are fuels made of organic matter such as coal, or oil. When fossil fuels are burned they give off a green house gas called carbon dioxide (CO2).

Also, mining coal and oil allows methane to escape. How does it escape? Methane is naturally in the ground. When coal or oil is mined you have to dig up the earth a little. When you dig up the fossil fuels you dig up the methane as well.

Another major man-made cause of global warming is population. More people mean more food, and more methods of transportation, right? That means more methane because there will be more burning of fossil fuels, and more agriculture.

Methane also comes from animal manure. Because more food is needed we have to raise food. Animals like cows are a source of food which means more manure and methane.

Along with the increasing population comes the increasing problem of transportation. More people mean more cars and more cars means more pollution. Also, many people have more than one car. That means that with more cars on the road, more chemicals and pollutants that are released into the air that damages the ozone layer and traps heat in the Earth's atmosphere.

Since CO2 contributes to global warming, the increase in population makes the problem worse because we breathe out CO2. Also, the trees that convert our CO2 to oxygen are being demolished because we're using the land that we cut the trees down from as property for our homes and buildings. We are not replacing the trees (an important part of our eco system), so we are constantly taking advantage of our natural resources and giving nothing back in return.

Another contributing factor to global warming, believe it or not, is water vapor. Water is both the most potent greenhouse gas per molecule and the most abundant in the atmosphere by concentration, but it is a short-term greenhouse gas, and great quantities of water can be added to the atmosphere by evaporation or subtracted by precipitation in a period of weeks.

So how can using alternative fuel help reduce global warming? The concept is actually quite simple. We need to reduce the amount of damaging emissions that are released by the burning of fossil fuels. Automobiles are a source of considerable pollution at the global level, including a significant fraction of the total greenhouse gas emissions.

The alternative fuels that are being developed release a considerably lower amount of environmentally damaging greenhouse gases and thus can put a great halt to global warming. We will never be able to stop the natural release of methane, water vapor, and carbon dioxide, but we can do a lot to help the ways we pollute the environment ourselves.

What about the cost factor? Is it cheaper to produce alternative fuels as opposed to producing gasoline? You might be surprised!

Chapter 8 - Alternative Fuel According To The Numbers

(Return to Contents)

We've already looked at what it takes to produce gasoline and why the price of gasoline is what it is. Besides paying the price for a barrel of crude oil, you have to factor in refinery operating costs along with federal, state, and local taxes. Is it any cheaper to produce alternative fuels? The answer is simply - sometimes.

Ethanol

Ethanol, as we've already addressed is basically 85 percent grain alcohol and 15 percent gasoline. It is a cleaner burning fuel and provides more horsepower than gasoline alone. While ethanol burns cooler than gasoline, it doesn't provide enough power to get an engine started on cold days which is why gasoline is added to the mixture.

With the rising popularity of E85 gasoline, more vehicles are being produced that can accommodate this new fuel. E85 fueling stations are currently available in 36 states (as of 2006), and over 6 million vehicles that can use E85 have been sold.

The performance of E85 vehicles is potentially higher than that of gasoline vehicles because E85's high octane rating allows a much higher compression ratio, which translates into higher thermodynamic efficiency. However, the flex-fuel vehicles (FFVs) that retain the capacity to run on gasoline alone can't really take advantage of this octane boost since they also need to be able to run on pump-grade gasoline.

Cynics claim that it takes more energy to grow corn and distill it into alcohol than you can get out of the alcohol. However, according to the Department of Energy (DOE), the growing, fermenting and distillation chain actually results in a surplus of energy that ranges from 34 to 66 percent.

Adding to that, the carbon dioxide (CO2) that an engine produces started out as atmospheric CO2 that the cornstalk captured during growth, making ethanol greenhouse gas neutral. Recent DOE studies note that using ethanol in blends lowers carbon monoxide (CO) and CO2 emissions substantially. In 2005, burning such blends had the same effect on greenhouse gas emissions as removing 1 million cars from American roads.

Opponents also point out that alcohol is a corrosive solvent. Anything exposed to ethanol must be made of corrosion-resistant (and expensive) stainless steel or plastic--from fuel-injection components to the tanks, pumps and hoses that dispense E85, as well as the tankers that deliver it.

Growing corn is an intensive process that requires pesticides, fertilizer, heavy equipment and transport. When considering the viability of ethanol, the total impact of all that activity needs to be taken into account.

However, the outlook is actually somewhat hopeful when it comes to replacing E85 as our primary source of fuel. According to the Renewable Fuels Association, 95 ethanol refineries produced more than 4.3 billion gallons of ethanol in 2005.

An additional 40 new or expanded refineries slated to come on line in the next 18 months will increase that to 6.3 billion gal. That sounds like a lot--and it is--but it represents just over 3 percent of our annual consumption of more than 200 billion gallons of gasoline and diesel.

One acre of corn can produce 300 gallons of ethanol per growing season. So, in order to replace that 200 billion gallons of petroleum products, American farmers would need to dedicate 675 million acres, or 71 percent of the nation's 938 million acres of farmland, to growing feedstock.

Clearly, ethanol alone won't kick our fossil fuel dependence--unless we want to replace our oil imports with food imports.

Methanol

Methanol is wood alcohol and, like ethanol, is blended in an 85/15 blend with gasoline. Methanol is produced through a steam and catalyst process that reconstitutes methane gas as methanol.

We know that methane gas is one of the primary causes of global warming and environmental degradation, but the way methane is processed into methanol safely turns it into safer methane. That safer methane can power vehicles with considerably less damage to the environment than methane by itself.

Currently, virtually all methanols produced in the United States uses methane derived from natural gas. However, methane also can be obtained from coal and from biogas, which is generated by fermenting organic matter--including byproducts of sewage and manure.

On a positive note, methanol is a potent fuel with an octane rating of 100 that allows for higher compression and greater efficiency than gasoline. Pure methanol isn't volatile enough to start a cold engine easily and when it does burn, it does so with a dangerously invisible flame. Blending gasoline with methanol to create M85 solves both problems.

However, critics will make a very different argument against methanol. Methanol is extremely corrosive, requiring special materials for delivery and storage.

Methanol, in addition, has only 51 percent of the BTU content of gasoline by volume, which means its fuel economy is worse than ethanol's. As with ethanol,

any potential increase in efficiency from methanol's high octane is negated by the need for FFVs to remain drivable on gasoline only.

The lower energy content and the higher cost to build methanol refineries compared with ethanol distilleries have relegated methanol and M85 to the back seat. Moreover, producing methanol from natural gas results in a net increase of CO2, hastening global warming. Unlike ethanol, the process liberates buried carbon that otherwise wouldn't reach the atmosphere.

In general, the prospect of methanol becoming a viable alternative fuel is in question. The EPA's Landfill Methane Outreach Program is tasked with reducing methane emissions from landfills, and much of this methane is used to produce energy.

As of December 2004, there were more than 325 operational landfill-gas energy projects in the States and more than 600 landfills deemed to be good candidates for projects. But the quantities involved are small. Methane also can be produced by processing biomass such as grass clippings, sawdust and other cellulose sources.

Based on these important differences between ethanol and methanol--not to mention the power of the farm lobby--methanol has receded into ethanol's shadow as a gasoline replacement. The last M85 FFV in the States was sold in 1999.

However, methanol may still have a future as a fuel. Nearly every major electronics manufacturer plans to release portable electronics powered by methanol fuel cells within the next two years.

Compressed Natural Gas

Natural gas can be used to fuel internal-combustion engines. The most practical strategy is to handle it as compressed natural gas (CNG).

Natural gas is typically found in underground deposits, often with petroleum, and is obtained by drilling. To use natural gas, the methane component--which makes up 50 to 100 percent of natural gas--must be processed to remove contaminants as well as other useful fuels such as butane and propane.

With an octane rating of up to 130, CNG has the potential to optimize an engine's thermodynamic efficiency through a high compression ratio. However, many CNG vehicles are able to run on either CNG or gasoline, which makes the octane advantage obvious.

According to the DOE, a CNG-fueled Honda Civic GX--the sole widely available CNG-only vehicle in the United States--produces 90 percent less CO and 60 percent less nitrogen oxides (NOx) than its gas-powered counterpart. And, CO2 is reduced by 30 to 40 percent. According to the company, the car's exhaust is cleaner than the air in some high-pollution areas.

For a vehicle to carry enough CNG to travel a reasonable distance, the gas has to be compressed to 3000 to 3600 psi (pounds per inch). At 3600 psi, CNG has about one-third as much energy as gasoline--about 44,000 BTU per unit volume--and the tank must be far larger, heavier and more expensive than a conventional one.

In addition, energy is consumed during the compression process. Currently available in nine states to Civic GX owners is a compressor/refueler called Phill that uses 2 kilowatt-hours (kwh) of electricity to compress the equivalent of 1 gallon of gasoline.

With electricity averaging 10 cents per kwh nationwide, the price of CNG goes up 20 cents per gallon over the cost of the natural gas itself. Still, CNG is a bargain compared to gasoline. A gallon of gas equivalent (GGE) costs about $1.20, including the cost of compression--thanks in part to the lack of taxes added to gasoline.

Even though 85 percent of our natural gas is produced domestically, and there's already a distribution network in place, CNG faces a limited future as a gasoline or diesel replacement. For one thing, like petroleum, it is nonrenewable. More critically, perhaps, there's already a great demand for natural gas--and CNG requires major retooling of both cars and fuel-station infrastructure.

Biodiesel

Probably one of the most exciting alternative fuels that are being developed is biodiesel fuel. Fuels for diesel engines made from sources other than petroleum are known as biodiesel.

Among the common sources for biodiesel fuels are vegetable oils, rendered chicken fat and used fry oil. Processing these oils into fuel involves removing glycerin and other contaminants through a process called transesterification.

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.

In addition, biodiesel burns cleaner than petrodiesel, with reduced emissions. Unlike petrodiesel, biodiesel molecules are oxygen-bearing, and partially support their own combustion.

According to the DOE, pure biodiesel reduces CO emissions by more than 75 percent over petroleum diesel. A blend of 20 percent biodiesel and 80 percent petrodiesel, sold as B20, reduces CO2 emissions by around 15 percent.

On the down side, pure biodiesel, B100, costs about $3.50--roughly a dollar more per gallon than petrodiesel. And, in low temperatures, higher-concentration blends--B30, B100--turn into waxy solids and do not flow. Special additives or fuel warmers are needed to prevent fuel waxing.

However, biodiesel has a viable future as a major fuel for transportation. According to the National Biodiesel Board, production of biodiesel in 2004 was about 25 million gallons, tripling to more than 75 million gallons in 2005. The trend is solidly upward, thanks to government incentives, the growing number of new diesel vehicles for sale and a grass-roots groundswell of support.

Like E85, biodiesel began with farm co-ops and local entrepreneurs. High fuel prices affect farmers, too, and here was an opportunity to make money from otherwise fallow farmland.

Country singer Willie Nelson, in partnership with several Dallas businessmen, has lent his name to Bio-Willie, a brand of B20 marketed mainly to long-haul truck drivers in California, Texas, the South and the Midwest.

Drivers praise the fuel for its low emissions, but obstacles to mainstream acceptance include a higher price than petro-diesel (seasonally and regionally, 10 to 25 cents a gallon) and the need to heat storage tanks in colder climates to prevent the fuel from gelling.

Electricity

The same flow of electrons that powers your television and iPod can provide the energy needed to move a vehicle. Electricity from a power source, typically a rechargeable battery pack, energizes a large electric motor that propels the car.

When slowing or stopping, the braking energy reverses the power flow, turning the electric motor into a generator to help recharge the battery pack. Under normal circumstances, however, the batteries must be recharged for several hours at a stationary charging station.

Vehicles that operate only on electricity require no warm up, run almost silently and have excellent performance up to the limit of their range. Also, electric cars are cheap to "refuel." At the average price of 10 cents per kwh, it costs around 2 cents per mile.

Electric cars can be recharged at night, when generating plants are under-utilized. Vehicles that run on electricity only part of the time and on internal-combustion power at other times--hybrids--have even greater promise. As hybrids gain in popularity, there is a growing interest in plug-in hybrids that allow owners to fully recharge the vehicle's batteries overnight.

A strong appeal of the electric car--and of a hybrid when it's running on electricity--is that it produces no tailpipe emissions. Even when emissions created by power plants are factored in, electric vehicles emit less than 10 percent of the pollution of an internal-combustion car.

But, pure electric cars still have limited range, typically no more than 100 to 120 miles. In addition, electrics suffer from slow charging, which, in effect, reduces their usability. When connected to a dedicated, high-capacity re-charger, some can be recharged in as little as an hour, but otherwise such cars are essentially not drivable while they sit overnight for charging.

While interest in plug-in hybrids grows, the long-term future of pure electrics depends on breakthroughs in longer-lasting, cheaper batteries and drastically lower production costs for the vehicles themselves. And then there's the environmental cost. Only 2.3 percent of the nation's electricity comes from renewable resources; about half is generated in coal-burning plants.

Hydrogen

Hydrogen is the most abundant element on Earth, forming part of many chemical compounds. Pure hydrogen can be made by electrolysis--passing electricity through water. This liberates the oxygen, which can be used for many industrial purposes. Most hydrogen currently is made from petroleum.

Though hydrogen can fuel a modified internal-combustion engine, most see hydrogen as a way to power fuel cells to move cars electrically. The only byproduct of a hydrogen fuel cell is water. This makes it a very clean burning fuel and one that is most definitely good for the environment.

There are, however, some drawbacks toward the outlook for using hydrogen as a viable fuel source. Most energy and industry experts agree that hydrogen fuel cell vehicles won't be widely available until 2020.

The industry still needs to develop a manufacturing and distribution system. And, despite the chemical simplicity of electrolysis, producing hydrogen is expensive and energy consuming. It takes about 17 kwh of electricity, which costs about $1.70, to make just 100 cu. ft. of hydrogen. That amount would power a fuel cell vehicle for about 20 miles.

Although hydrogen has the highest energy-to-weight ratio of possible energy sources, it's necessary to expend a tremendous amount of energy to compress sufficient hydrogen into an expensive, 5000-plus-psi storage tank in a vehicle.

Another option is freezing: Cryogenic hydrogen boils at minus 423 F. This requires energy to refrigerate and compress the hydrogen to liquefy it, and more energy to maintain that temperature in a super-insulated tank.

Despite the doubts of some experts, the outlook for hydrogen as an alternative fuel source on the open market is actually quite good, although not in the near future. The world's carmakers are deeply engaged in hydrogen fuel cell research. Some carmakers continue to work on hydrogen-fueled, internal-combustion engines. But, the stumbling block is finding a cost- and energy-effective way to produce hydrogen.

Now that we've covered the bases on alternative fuels for cars – let's think about alternative fuels for our homes. There are many options you can look at to heat and cool your house or business.

Alternative Fuels For Buildings

The phrase "alternative fuels" is usually used to mean fuels for motor vehicles that are not gasoline. Alternative fuels can also refer to any fuel that is not a fossil fuel. Sometimes the phrase is used inaccurately to refer to alternative sources of energy or power, for example, hydroelectric dams and geothermal power plants.

The search for alternative fuels has a long history in the United States. For instance, the Stanley Steamer automobile, unlike cars with internal combustion engines, could be powered with several different fuels: gasoline, raw petroleum, coal, charcoal, oil, and wood. By the mid-1920s, however, the Stanley Steamer

was no longer manufactured, and gasoline was the fuel of choice for motor vehicles.

Smog created by the burning of coal, gasoline, and other petroleum derivatives created serious health hazards in American cities by the 1940s, and thereafter caused environmental damage even in remote wilderness areas by poisoning trees and other wildlife. By the 1970s, acid rain was a significant presence and poison in the nation's waters. Individual states and the federal government began enacting laws intended to limit and eventually end AIR POLLUTION.

The lists of alternative fuels that can used to power a home – more specifically heat it include:

- Natural Gas
- Propane
- Electricity
- Fuel Oil
- Solar Power

Geothermal heating systems are also growing in popularity. A geothermal system takes advantage of the Earth's ability to store vast amounts of heat in the soil ("geo" means earth and "thermal" refers to heat). This heat energy is maintained at a constant temperature (50°F to 70°F depending on latitude) in the soil and near-surface rocks. In Wisconsin, the soil maintains a 50°F temperature beginning approximately four feet down, well past the winter frost line.

Geothermal heating systems, also called ground-source heat pumps, "capture" this steady supply of heat energy and "move" it from the Earth and through a home or building. Basically, once installed, a home or building owner will use much less energy, save money each month, and reduce the amount of pollution produced by fossil fuel systems.

In Wisconsin, for example, two school districts recently began installing geothermal systems at area high schools. In both Fond du Lac and Evansville, district administrators were "sold" on this technology's energy efficiency and its ability to yield long-term cost savings. Schools across Wisconsin and the country have faced skyrocketing energy bills and they are searching for cost-effective alternatives. Geothermal systems represent a proven option. In addition, they utilize a renewable energy source—the Earth's naturally-occurring heat energy.

A heat pump is a mechanical device that transfers heat from one source to another. Ground-source units pull heat from the earth and transfer it to homes or buildings. Heat pumps (despite their name) can provide both heating and cooling. The cooling process is simply the reverse of the heating process: heat is taken out of a building and returned to the Earth.

Typical ground-source heat pumps transfer heat using a network of tubes, called "closed loops." Basically, the loops are filled with water, refrigerant or an anti-freeze solution. They run through the ground in the vicinity of a building and the liquid absorbs the Earth's heat energy. Then, this warmed liquid is pumped back through the system into the building. This process provides heat to the building space. Once the fluid passes through the building and transfers its energy, it flows through the loop system back to the Earth and the process repeats itself.

In the summertime, these systems "reverse" into cooling mode. Technically, the system does not "run backwards." Instead, a series of valves enables the system to switch the "hot" side and the "cold" side. The heat from the building is transferred to the liquid in the loop and this liquid is pumped back into the ground. When the ground source heat pump is in cooling mode, it usually has an excess of warmed liquid in the system. This liquid can heat water for the building and basically eliminate the use of the hot water heater during the summer months.

Ground-source heat pumps can use 25%-70% less electricity than conventional electric heating and cooling systems. First, in winter heating mode, a ground-source heat pump uses energy from the Earth to provide heat, whereas air-source heat pumps try to extract the last bits of heat energy out of cold winter air. Because of the long, cold Wisconsin winters, air-source heat pumps are not effective or efficient.

Second, ground-source heat pumps are more energy efficient than conventional electric heaters because they maximize the thermodynamic advantage of a heat transfer fluid. This benefit enables the ground source heat pump to produce more heat energy output than electric energy input.

Conventional electric heaters on the other hand don't quite produce as much heat output as electric input. Under some conditions, a ground source heat pump cannot meet the required heating needs. In these cases, supplemental heat must be provided from another source which is a usually conventional electric unit.

Finally, during the summer, the ground source heat pump "reverses" into cooling mode. This fact makes the ground-source heat pump more energy efficient for cooling than a traditional air conditioner.

When a de-superheater is installed, energy from the ground source heat pump can be transferred to the hot water tank. As a result, building occupants receive "free" hot water in the summer and very low-cost hot water in the winter.

Most of a ground-source heat pump's electrical energy requirement (70% to 80%) is consumed by the compressor and pump that combine to move heat energy to or from the ground, through the loop system, and into or out of a building. The remaining 20% to 30% of the electricity is used for fan(s) and controls to distribute the conditioned air throughout the building.

A ground source heat pump system including the underground loops, costs about $2,500 per ton of capacity, or roughly $7,500 for a 3-ton unit which is a typical residential size. Approximately half of this cost is related to the geothermal loop configuration. It can be expected to last from 20 to 30 years with minimal maintenance. A conventional heating and cooling system can cost up to $4,000.

At first glance, this price difference of $3,500 may seem impractical and too costly. However, buyers must carefully consider monthly energy costs over the life of the equipment when making a decision. As the school administrators in Fond du Lac and Evansville learned this past year, rising energy prices can destroy annual budgets and geothermal systems are a good way to minimize future price shocks.

Since these systems use from 25% to 50% less energy than conventional systems, users will spend less on their monthly energy bills. In fact, many homeowners could spend from $35 to $70 less per month, meaning that most ground source systems will "pay for themselves" in 2 to 10 years. The additional cost of $3,500 will be recovered from the monthly energy savings. After the "payback" period, the owner will simply pay much-reduced utility bills.

Ground-source heat pumps can be retrofitted in existing homes that have traditional forced-air systems. In most cases, the heat pump can be connected to the existing ductwork while the loop system is installed outside in the ground adjacent to the home.

Geothermal systems and ground source heat pumps could provide a viable alternative to fossil fuel based systems and lessen the amount of air pollution caused by those fossil fuels.

Another wonderful, and probably the most promising, alternative for fueling our homes is with solar power. The amount of energy that we can harness from this amazing star is probably heads and tails more advantageous than any other power source.

Solar power is probably the cleanest, most viable form of renewable energy available and it can be used in several forms to help power your house. Many gardens now use solar lights or solar garden water features. The availability and wide use of solar power in gardens shows exactly how versatile it is as a source of energy.

The technology and the systems are becoming smaller, more compact and better looking than when they were first created and used. Early examples of solar power systems can be seen in California where, in the 1980s, enough solar power panels were installed to power over 10 million homes.

Simply put photovoltaic tiles and other forms of solar energy work by converting some of the energy in sunlight into a clean form of electricity that can be used in houses and other buildings. The PV cells consist of a positive and a negative slice of silicon placed under a thin slice of glass.

As the protons of the sunlight beat down onto the PV cell they knock the neutrons off the silicon. The negatively charged free neutrons are attracted to the silicon but are trapped by the magnetic field that is formed from the opposing fields. Small wires on the silicon catch these neutrons and when connected in a circuit an electric current is formed.

This reaction gives direct current electricity though, and it must be passed through an inverter to be converted into an Alternating Current used in our homes to power any electrical items. Some of the power is lost in this part of the

process as the inverter is only around 95% efficient but this is a much greater efficiency than was once available.

The nature of the PV cell means there is little or no maintenance required and there are no moving parts; this means that a typical PV cell can last up to 40 years with no work besides an annual clean.

There are several ways to use solar power around the house and not just for powering. You can use it to heat your hot water, heat your pool or even your central heating or if you have plenty of roof space and a reasonable amount of sun you can get a grid tie system; a grid tie system means that not only can you power your entire house but during those times when you create an excess of electricity you can sell it back to the grid.

An efficiently solar powered home will be able to reasonably create between 75 and 100% of their own power. Because of the grid tie system this means you may not have to pay for electricity ever again!

The major downfall of solar power is the very part of it that makes it run – the sun. Unfortunately, the sun doesn't always shine which makes it an inconsistent source of energy. However, usually, there is a certain amount of stored up energy for these days. If they last more than a day or two, however, you will need to have an alternate power source.

Turning your home to solar power can be an expensive proposition sometimes, but in the long run, it will save you tons of money. You won't be held captive by the power company anymore and will see the difference in your budget. You can even install solar power yourself in your home if you are an avid do-it-yourself; just make sure that your new power source meets all local and federal building guidelines.

While natural gas, propane, electricity and fuel oil continue to heat most homes, many homeowners rely on wood, coal, and other more unusual fuel sources such as corn for winter comfort. Those fuels can provide abundant heat, but require some additional safety precautions.

Every heating unit that uses an open flame needs air for combustion Efforts to make homes more weather-tight with improved caulking, siding and/or insulation, and better windows and doors, may restrict the amount of combustion air available. Outside air should be provided for combustion through an air exchanger or vent that warms the air it enters the home.

The addition of a wood stove, furnace, fireplace, gas clothes dryer, gas stove or gas water heaters increases the demand for combustion air. If that demand is not met, there is a grave danger of carbon monoxide poisoning for the residents.

The chimney of an alternate fuel heating system needs attention every year before the heating season, he says. When wood or coal is used, preventing chimney fires should be a major concern. Soot and creosote can build up to dangerous levels.

Wood stove and fireplace chimneys should be cleaned and inspected every year. Masonry chimneys should be inspected for cracks, crumbling mortar, obstructions, and creosote deposits. Prefabricated metal chimneys need to be inspected for corrosion, tightness of the joints, and creosote deposits.

Chimney cleaning and inspection should be done by qualified, trained persons. It is not a job for amateurs or the average home owner, so don't try to do it yourself. Leave it to the pros.

Annual safety inspections for wood burning stoves and fireplaces are also necessary. Cracks and other defects such as leaky door seals, broken or loose

hinges, and faulty draft regulators are common problems. Examine the legs of wood stoves to make sure they provide a sturdy and secure base for the stove. If the wood stove has a cracked glass insert in the door, it should be replaced.

If an older stove has major defects such as warped panels or other defects from overheating, you will need to replace the entire stove for safety reasons. Your life depends on the safe operation of that stove, so don't trust it for another year. Replace it now.

Home owners who have not used a wood burning stove or heater lately should review management and operation procedures before starting a new season. Check to make sure minimum clearances from combustible surfaces have been maintained? Make sure the stove is still on it's fire-resistant base. Remind youngsters that the hot stove should not be touched or played with. Consider how you will handle and dispose of hot ashes. Remember to use only metal containers.

A slow burning fire creates more creosote than a faster one. When creosote buildup occurs frequently, adjust the draft of the fire to provide more air and speed up combustion. An occasional faster burning fire can help to reduce creosote buildup when there isn't too much, be sure to check it first.

You will also need to make sure that you have smoke detectors, ideally, in every room of your house. It's not uncommon to find smoke detectors with missing batteries in homes heated with wood or coal. An occasional, accidental release of smoke sets off the alarm and soon the battery is disconnected or removed. Careful location of the detector and better management of the wood stove can prevent the false alarms and still allow the detector to provide protection.

Most insurance companies provide discounts on insurance premiums to clients who have smoke alarms in their homes. Test smoke alarms frequently and

replace the battery whenever it becomes weak. Replace any alarm that doesn't function properly during a test. The price of a smoke alarm is cheap when compared to the cost of a house fire.

Also, you will want to check with your tax man regarding tax incentives you can get on your income taxes when you have an alternative fuel to heat and cool your home. Especially with solar powered systems, you can get huge tax breaks as the government continues to try and make our environment thrive and combat global warming and a depleted ozone layer.

This leaves us at a great point to discuss just how the government is trying to help sway Americans towards using alternative fuels.

Chapter 9 – What's Uncle Sam Doing?

(Return to Contents)

While some people think the government isn't doing anything to curtail the skyrocketing gas prices, the truth is that they really are. Because we are unable to produce the amount of oil that we need ourselves here in this country alone, we have to rely on outside oil sources. That leaves the United States at the mercy of the other countries who will set their prices as they see fit.

Way back in 1949, the country of Venezuela approached Iran, Iraq, and Saudi Arabia to discuss the possibility of forming an organization that would unite them in their common interests as the primary oil-producing nations in the world. Eventually, the other oil-producing countries decided to form with these founding countries and the organization OPEC was formed.

The problem with OPEC (Organization of Petroleum Exporting Countries) is that they have banded together to protect their own interests when it comes to their oil exports. What that means is that if they all agree on a price of a barrel of oil, that's what it will be even if the rest of the world protests. Some people feel OPEC has hurt our world more than help it - although the countries who are members of OPEC certainly don't feel that way.

It is for this very reason that the United States along with other countries are so passionate about reducing our dependence on foreign oil through the use of alternative fuels. Because we always seem to be in conflict with oil-rich nations, those conflicts tend to make our gas prices raise. American is not about to back down when world safety is at risk, so looking at alternative fuels in every single way just makes sense.

President George W. Bush recently took part in a demonstration of alternative fuel vehicles with the CEO's of Ford, General Motors, and Daimler Chrysler. He

came away from this demonstration with a real sense of hope that our dependence on foreign oil would be significantly decreased with the development of these new cars and trucks.

We've already mentioned tax incentives elsewhere in this book, but this, perhaps, is one of the best things that the government can offer the American people to purchase and use an alternative fuel car. If you can reduce the amount of taxes you have to pay every April just by buying – at the very least – a hybrid vehicle, it's certainly worth it!

The government is also offering grants and subsidies to organizations that have large fleets of vehicles to make the switch toward alternative fuels. There are hundreds and hundreds of buses, semi-trucks, and delivery vehicles on the road today – all contributing to the smog, pollution, and degradation of our environment.

Government grants allow these organizations to either purchase new alternative fuel vehicles or to convert them so that they can run on the new fuels that are available. This has helped school systems, trucking companies, and many other places make their cars, trucks, and buses help the environment and not have to pay exorbitant gas prices. With the trickle down effect, you can see that this will help keep the price of consumer products lower to us – the consumer.

Now, we're not saying the oil industry is an evil empire. They serve a very necessary purpose in the modern world. However, I don't think many people would disagree that things are quickly getting out of hand and something needs to be done.

The fact is that oil and oil production damages the environment in many ways. The images can be disturbing:

An oil spill washing up on the beaches of a tropical island:

Smog hovering over an oil refinery:

The toxic smoke released after an oil refinery explosion:

A dead animal fallen as a result of the Exxon Valdez oil spill:

Another casualty of the Exxon Valdez:

A rolling tide coming ashore rife with oil from an oil spill:

The extent of an oil spill in the ocean:

Conclusion

We have been given a great gift in the world we live in. Here on Earth, we have everything we need to survive. In an ideal world, we would all be able to work together to insure the survival of each other with little to no strife and conflict.

However, we don't live in an ideal world. There are wars, disagreements, and people who want to control what they have and make others pay a premium price to get it if they need it. With free enterprise, we have created a world where we need to rely on each other for the things we need.

One of the things we need is energy and fuel – energy to power our homes and businesses and fuel to allow us to travel, heat our homes, and make life comfortable. We used to think that the only way to get the fuel we needed was to use the natural resources of coal, oil, and other minerals. What we didn't consider is what those resources would do to our world over a period of time.

We are in a real crisis right now, and we must take note of what needs to be done before it is too late and we end up living in a very different world – perhaps a nearly uninhabitable one. It's scary to think about.

Exploring the use of alternative fuels both for our vehicles, the number one cause of environmental damage, as well as for our homes and businesses is necessary and a step in the right direction. It can start with just one person. Will that person be you? Now that you have all the information you need, it's time to take action. Can you? Will you? We hope so!

This e-book is a publication of http://www.SuccessQuest.info

You can get tons of products like this one simply by joining our exclusive Gold Member's Area. We also have a free discussion forum there for you to interract with us and other members. Find out what all the buzz is about and go on over to SuccessQuest.info today!