Alternative Fuels

Why Use Alternative Fuels?

Importance of Transportation

Transportation is an extremely important element for the day-to-day functioning of the United States. Without transportation the entire country would, literally, come to a standstill. It is virtually impossible to imagine life without some form of transportation. Privately owned cars, motorcycles, trucks, public buses and subways, trains, planes and boats are all a daily part of our lives. The New York City Department of Transportation makes sure that public transportation services (buses, subways and trains) are able to properly serve the New York City population and that infrastructure (roads and bridges) are properly maintained in order for New Yorkers to move safely around the City.

However, most of us know that transportation, though necessary, is also causing harm to the environment and to our health. The problem is that automobiles, buses, and trucks – the most commonly used forms of transportation – require gasoline for fuel. Gasoline is a refined by-produc of oil, a fossil fuel. Diesel fuel, mainly used for heavy duty vehicles such as buses and trucks, is th cheapest and crudest form of gasoline, and is the most hazardous fuel because it emits a tremendously higher level of pollutants per mile than conventional gasoline. The danger in gasolin and diesel and other fossil fuels (except natural gas) is that they contain certain gases that, when released into the air, negatively affect air quality and damage the environment. These particular gases are not compatible with the respiratory systems and processes of life on Earth. As well, these gases are an unnatural addition to the delicate atmospheric balance of gases that work together to sustain and protect life on Earth. As a result, gases from fossil fuel emissions have caused and are continuing to cause great damage to the atmosphere (such as the greenhouse effect and acid rain).

Another problem with gasoline is that its source product – oil – is found in countries other than the United States. This means that we depend on other countries for one of our most vital necessities. Our transportation system is over 90 per cent dependent on oil with over 50 per cent of our supply coming from overseas. Since 1999, the price of oil has risen dramatically. The use of alternative fuels to power our cars, buses, and trucks would significantly reduce our dependence on foreign oil. This would also benefit our economy since alternative fuels can be produced in the U.S.

The other pressing issue with our use of oil is that it is a finite resource. This means that it cannot be regenerated and once we have depleted all known reserves that will be the end of our ability to use gasoline. It is predicted that, at this time, we have approximately 35 to 40 years left of oil, based on current usage figures. This is a frightening fact that we need to acknowledge and act upon!

In order to prepare for the future we must become farsighted and work towards expanding our knowledge and use of other fuel sources so that we can gradually shift our reliance from oil to these other cleaner and more abundant fuel sources.

Alternative Fuels in New York City

The main alternative fuel choice in New York City, at present, is compressed natural gas (CNG). Although natural gas is a fossil fuel it is, as mentioned before, the one fossil fuel that is actually quite clean. CNG emits less nitrogen oxide (NOx) and particulate matter (PM) than gasoline. Natural gas buses have been proven to produce an average of 97% less particulate matter (PM), 84% less carbon monoxide (CO) and 58% less nitrogen oxide (NOx). There are a total of 17 CNG fueling sites across the five boroughs (including 3 in Manhattan). These fueling stations are owned and operated primarily by the two New York City utilities (KeySpan and Con Edison). All are open to the public.

Ethanol (E85), a mixture of 85% ethanol (a fuel derived from the fermentation of cereal) and 15% gasoline, is also becoming popular. However, no private fueling E85 stations exist, at present in New York City. Development of E85 refueling sites is key to the expansion of E85 use in New York City. Every Ford Taurus made since the late 1990's has been E85 compatible but consumers cannot choose to use E85 unless E85 refueling sites exist.

Electricity for electric vehicles is also being used by both public and private New York City fleets. There are no public charging stations in place in New York but electric vehicles are used, primarily, for short-distance travel within the City and are re-charged every evening after being used. Public fueling sites are important to develop, however, as private citizens who want to purchase EVs will want the assurance that they can re-charge their vehicles, if need be, during the day and, if travelling outside the City, owners should be able to locate a re-charging site easily. Accordingly, development of re-charging infrastructure must extend outside of New York City and this will only happen if there is consumer demand.

The Alternative Fuels Program is working hard to promote the use of alternative fuels and alternative fuel vehicles in New York City but its main challenge is to develop re-fueling sites for alternative fuels.

Why Use Alternative Fuels?

Environmental Damage

Fossil fuel emissions from vehicles damage the environment and contribute to air pollution. Several major environmental problems are caused by the use of fossil fuels:

Global Warming

Global warming, also known as the "Greenhouse Effect", is caused by an accumulation of carbon dioxide (CO2) emissions that do not leave the Earth's lower atmosphere. CO2 is the gas responsible for keeping the Earth's climate warm because it absorbs radiation that would otherwise leave the Earth's atmosphere and disperse into the upper atmosphere. CO2, in moderate amounts, is necessary in order to maintain a certain temperature that supports life on Earth. However, an excess amount of CO2 in the Earth's atmosphere is building up due to fossil fuel emissions that contain large quantities of CO2. The CO2 has formed a thick blanket that traps heat near the Earth's surface. Fossil fuels are the largest producer of CO2 emissions and the

significant use of fossil fuels is thickening the CO2 blanket over the Earth. This blanket traps ultra-violet (UV) rays (which are essentially heat) that have been originally received by the Earth from the Sun.

- The Natural Process of Heating and Cooling of the Earth's surface: UV rays coming from the Sun hit the Earth's surface and warm the Earth. These UV rays, after hitting the Earth's surface, should then be bounced back up into the atmosphere.
- The Greenhouse Effect: The unnatural accumulation of CO2 in the lower atmosphere is forming a thick blanket that is preventing the second part of the natiral process - UV rays leaving the Earth's atmosphere from occuring. The UV rays travelling from the Sun are able to penetrate the CO2 blanket and arrive at the Earth's surface but they are unable to penetrate the CO2 blanket after they are radiated back up from the Earth's surface. Therefore, they remain trapped near the Earth's surface and are constantly being bounced back and forth by the Earth's surface and the CO2 blanket.

It is important to note that the warming and cooling process of the Earth is a delicate process. The Sun's rays are the main source of warmth for the Earth's surface. However, these rays are extremely strong and are hot enough that they only need to have contact for a brief period with the Earth's surface in order to warm it. These rays, after hitting the Earth, are then supposed to bounce back into the atmosphere and this allows the Earth to remain at an optimal temperature that is comfortable for all life on the planet and ideal for the established global climate. With the occurrence of the CO2 blanket and the accumulation of UV rays near the Earth's surface, the temperature on Earth is rising because the natural process of the rays only remaining long enough to warm the surface has been disturbed. The trapped UV rays are remaining near the Earth's surface and are burning human, animal and plant tissue. This is reflected in the increased incidence of cancer among the world's population. The additional heat that is now being trapped near the Earth's surface is also causing a general rise in global temperatures and a melting of million year old glaciers. As a result, a significant increase in the water table is occurring. The increase in water tables mixed with heat is creating excess humidity in the Earth's lower atmosphere and this is causing an increase in heavy precipitation and storms. As a result, weather patterns are being affected. A shifting of weather patterns will cause storms, heat waves and droughts that will lead to possible crop failures and famines. Tropical diseases will increase due to the increase in temperature. Rising ocean and lake levels will lead to coastal flooding. The economy will be affected by all of this environmental disruption and the delicate balance of ecosystems will be disrupted resulting in the eradication of plant and animal life.

All of this may sound very dramatic but it is not just a possibility – it is already taking place! We need to take immediate action to try and stop this process that we have set in motion.

Oil Spills

An oil spill is a major environmental disaster and it occurs when an oil tanker transporting oil to shore from an ocean-based oil rig sinks and the oil cargo is released into the ocean. An oil spill can also occur when an oil rig, located in the ocean, accidentally leaks or explodes. It is also important to note that when an oil spill occurs on water it is extremely difficult to prevent the oil from spreading. It is also impossible to clean up an oil spill that occurs in water. Pollution to oceans is extensive and countless fish, other valuable and beautiful forms of marine life, and coastal lines (where the oil eventually washes up) are disastrously affected. Oil spills may not appear to be a major threat to the environment because they normally occur in very remote areas. However, the oil that is released into the ocean from an oil spill, spreads very far and affects large areas of ocean life. Eventually, the oil reaches coastal land and destroys the animal and plant life that are part of the coastal ecosystem. Oil is a toxic and poisonous substance. It is important to remember that oil is retrieved from deep below the Earth's surface. It is not meant

to be exposed directly to the environment because human, animal and plant life, plus the natural functioning of the atmosphere, are not adapted to deal with the chemical composition of fossil fuels.

Another type of oil spill can occur when a land-based oil pipeline bursts or leaks. Unfortunately, oil spills occur too frequently.

Acid Rain

This is an after-effect of the use of oil and coal. When oil or coal is burned through combustion in an engine, sulfur contained in the oil is released through the emissions of the combustion and produces gaseous sulfur dioxide. The amount of oil and coal used each day around the world produces a large quantity of sulfur as a result of the fuel combustion that takes place. Even though the sulfur content of fossil fuels is so low, millions of tons of sulfur are released into the air each year due to the heavy use of fossil fuels. Globally, sulfur dioxide emissions are about 100 million tons annually and are increasing due to sudden Third World industrialization. Acid rain occurs because sulfur dioxide and nitrogen oxide are released through fossil fuel combustion. Due to complex chemical reactions that take place in the atmosphere, sulfur dioxide is transformed into sulfuric acid and nitrogen oxide is transformed into nitric acid. These acids are found in rain clouds and disseminated back to the Earth's surface through precipitation (i.e. rain, snow). Polluted precipitation is acid-rich and is collected in groundwater and released into rivers, lakes and oceans. Not only does secondary pollution contaminate water on Earth, it also causes other harm to the environment such as the destruction of valuable forests (the acid in the precipitation "burns" trees and changes the sediment content of soils) and contaminates human-grown crops (through contamination of the soil). As well, fisheries and other animal life that create their habitat in/near water systems are affected because marine life cannot thrive in waters that are heavily acidic. This, in turn, affects other animals that rely on fish and water for sustenance.

Air Pollution

Pollution can be defined as anything that causes a reduction in purity. Therefore, air pollution can be defined as the reduction in purity of the air. (Air on Earth is what is contained in the atmosphere – the layer nearest to the Earth's surface.) Most of the Earth's air pollution is caused directly as a result of emissions from fossil fuels. The process of combustion (which occurs when a fossil fuel runs through an engine and is "burned" in order to create energy/heat) releases gases and minute particles (found in fossil fuels) into the air. All life on Earth depends on air for the basic respiratory processes. Plants, animals and humans all depend on balanced amounts of the following gases found in the air: oxygen (O2), water vapor (H20), and carbon dioxide (C02) – as a basic requirement of life. Since the gases and particles released from fossil fuel emissions are not naturally present in the air, they are, therefore, not compatible with the basic respiratory processes that all forms of life have developed over millions of years. When foreign substances are introduced into the air, it is obvious that the natural balance of life on Earth will be affected as the respiration processes of all life on the planet are not adapted to these "pollutant" gases.

Gases released from fossil fuel emissions that cause the greenhouse effect are also polluting the air. Carbon dioxide, nitrogen oxides, and methane – the three most prevalent greenhouse gases – are also responsible for lowering the quality of the air that we breathe. Particulate matter, although not a greenhouse gas, is also an air pollutant released from fossil fuel emissions. Ozone is a gas that is created in the atmosphere by reactions between several of the gases released from fossil fuel emissions and is considered a pollutant because it is a powerful irritant to the human respiratory system. (Ozone gas, found in the lower atmosphere, is a completely different subject from the destruction of "ozone layer" which is located in the stratosphere.)

Carbon dioxide, produced from fossil fuel emissions, is not a poisonous gas. It is, however,

dangerous to the Earth's natural climate system because when excessive quantities are produced it forms a blanket in the lower atmosphere and traps harmful radiation from the Sun's rays near the Earth's surface. (This occurs because CO2 does not disperse into the upper zone of the Earth's atmosphere.) Nitrogen oxides contribute to smog generation. Particulate matter is comprised of tiny particles that remain in the emissions of fossil fuels. A more detailed explanation of PM and why it is so hazardous can be found in the following section.

Health Threat of Fossil Fuel Use

Carbon dioxide (CO2) and nitrogen oxide (NOx) are poisonous gases that are dangerous to humans when inhaled. These gases are produced mainly from mobile source emissions (i.e. vehicle exhaust emissions). Exposure can result in upper respiratory illnesses such as asthma and emphysema. Increased rates of respiratory illnesses in urban centers (areas where fossil fuel exhaust emissions are highest) have been documented for the past several years. Children and the elderly are the most susceptible to developing asthma and other respiratory illnesses as a result of exposure to fossil fuel emissions. Cases of asthma and respiratory illnesses are increasing at alarming rates among the entire population because of the increase in the concentration of carbon dioxide, nitrous oxide and particulate matter (PM).

Particulate matter (PM) is released in fossil fuel emissions alongside carbon dioxide (CO2) and nitrogen oxide (NOx). PM is of extreme concern to human health.

Here's a more detailed explanation of what PM is and why PM is so dangerous: When fossil fuels are used, their emissions contain residual chemical matter that is very, very fine. Have you ever seen the black fine dust that accumulates on everything in a large city? Or have you ever seen black smoke being emitted from a car, truck or factory smokestack? Well, the smoke, also called "soot", contains fine particles that are the result of chemical components being released from a substance – namely, fossil fuels. The worst type of particulate matter comes from coal and from diesel fuel. Diesel fuel, the cheapest and crudest form of gasoline, is the most hazardous fuel because it emits 10 times more particulate matter per mile than conventional gasoline engines. (From a study by the Joseph L. Mailman School of Public Health at Columbia University, New York, New York; "Airborne Concentrations of PM 2.5 and Diesel Exhaust Particles on Harlem Sidewalks: A Community Based Pilot Study", by Patrick L. Kinney et al., 2000)

Particulate matter (PM) is essentially a mixture of solid particles and liquid droplets. These particles are so minute that we cannot see them but they are in the air that we breathe. They are dispersed through vehicle emissions and remain suspended at low levels, so that when we breathe, these particles enter our nose and mouth and become embedded in the deepest recesses of the lungs. Numerous scientific studies have connected particulate matter with the following health dangers:

- Premature Death
- Cancer
- Acute Respiratory Illnesses (asthma, chronic bronchitis, painful breathing)
- Shortness of Breath
- Heart Disease
- Lung Damage

More than 40,000 Americans die each year from illnesses caused by breathing particulate matter (PM). As with the effects of carbon dioxide (CO2) and nitrogen oxide (NOx), the elderly and children are most susceptible to illnesses as a result of exposure to PM.

Coal, another fossil fuel, is no longer used as a transportation fuel. However, it is still used

throughout the world to generate electricity in factories. Even this moderate use of coal is dangerous because it contains carbon dioxide (CO2), nitrogen oxide (NOx) plus the highest levels of sulfur dioxide of all the fossil fuels. Coal is very harmful to the environment and its use must be controlled.

However, diesel fuel is still used, mainly by heavy-duty vehicles such as trucks and buses even though it contains more than 40 toxic air pollutants (as listed by the US EPA), many of which are known human carcinogens. In the United States alone, diesel particulate pollution is responsible for causing over 100,000 cases of cancer. (From: "Health Effects of Diesel", Clean Air Network, May 2000) Also, diesel emits approximately 62% more NOx than CNG.

Pollution from diesel engines is one of the most critical air pollution problems in the United States. You know that a vehicle is using diesel when you see black, sooty exhaust being spouted from a vehicle's tailpipe. Although only 2% of all vehicles in the U.S. run on diesel, they cause 27% of the smog-forming pollution and 66% of the soot produced by all of the nation's motor vehicles. Since most vehicles that use diesel are heavy duty (trucks, buses), the harmful emissions from diesel are produced in huge amounts. Big trucks and buses are responsible for more than 15% of the transportation-related emissions of CO2 and this proportion is growing faster than CO2 emissions from other sources One diesel truck can emit as much pollution as 100 cars. Diesel-powered vehicles account for nearly half of all NOx emissions and more than two-thirds of all particulate matter (PM) from US transportation sources. (From: Union of Concerned Scientists, "Diesel Engines and Public Health")

Running Out of Oil

Transportation is the main reason that the U.S. currently depends so heavily on crude oil. Most of this oil is imported from foreign countries and the major source of foreign crude oil is the Persian Gulf (this region provides one-fourth of the world's current consumption of oil and nearly two-thirds of the world's oil reserves). Due to supply depletion and distribution instability, reliance on this fossil fuel must end. Oil is a finite resource, which means that its supply is limited and cannot be reproduced. It took millions of years for these oil reserves to accumulate and we have used them up in less than two hundred years! It is estimated that the current known reserves of oil on Earth will only be able to supply total world demand for the next 40 years. When these reserves are completely exhausted we will have to use alternative fuel sources. In the short-term future, there are alternative reserves available. Southwestern Russia, Eastern Canada and other countries have short-term (up to 30 years world supply) oil reserves. However, for the long-term, it is important to start planning as to what we will do when these finite supplies are exhausted.

As well, fossil fuels tend to be found mainly in geographic areas located in countries with unstable political conditions. Therefore, Americans are reliant upon an energy source that will eventually no longer exist and that, while still in existence, is not a secure supply due the unpredictability of foreign political conditions that govern supply and pricing. The latter conditions, supply and price, are dependent on each other and a change in either is especially disruptive to the U.S. and world economies. The best example of what can happen if supply is suddenly restricted is the Iranian Revolution's effect on world oil prices in the late 1970's and early 1980's. The political tension between Iran and the West, caused by the revolution, curbed oil supply and forced prices to soar to extreme heights. This oil shortage created havoc and illustrates the need to rely more on non-foreign sources of fuel. Due to this long-term oil shortage, Americans were forced to endure drastic shortages of gasoline for almost eight years due to the fact that the main source of crude oil for the U.S. at that time was Iran and the Persian Gulf. The supply shortage forced prices to skyrocket and forced Americans to reduce their use of oil considerably. It was at that time that the U.S. began research and development of alternative fuels. Also, Americans learned how to

war ended and oil supply returned to normal, the U.S. abandoned its investigation into alternative fuels and Americans forgot about using energy efficiently and indulged in the abundant supply of oil once again.

What Can Be Done?

The solution lies in the use of alternative fuels. Most of these alternative fuels are renewable which means that their supply is infinite and that they can be produced and supplied forever without any fear of depletion. As well, these fuels can be produced here in the U.S. so there is no need to rely on foreign countries for fuel supply. These alternative sources of fuel are currently being researched and developed.

Types of Alternative Fuels

The major alternative fuel sources for the future will be:

Natural Gas

Natural gas, although a fossil fuel, is considered to be an alternative energy source because it is a preferable alternative to oil. You may say, "Why is natural gas considered to be an alternative fuel? Isn't gas a fossil fuel?" You are right – natural gas is a fossil fuel but it is different from gasoline, petroleum and coal because it does not contain the same harmful compounds found in other fossil fuels. Unlike gasoline, petroleum and coal, natural gas has a negligible sulfur dioxide content, does not contain lead, has a low nitrogen dioxide content, a low particulate content, and a low carbon monoxide content. As well, natural gas does not require carcinogenic (cancer-causing) additives to boost octane levels because natural gas is naturally high in octane. In addition, natural gas is still abundantly available which means that it is practical to rely on its continued supply for hundreds of years into the future. With all these pluses, natural gas is the "natural choice" for New York City!

Natural gas has not been used very much and, as a result, abundant supplies still exist. Not only is natural gas plentiful in supply, it is also a clean source of energy. However, it is not renewable which means that supply, although plentiful at this time, will eventually be depleted. That is why it is so important to develop other sources of alternative fuels.

Bio-Fuels (from the natural gases found in plants and organic matter)

Ethanol is the main bio-fuel used today. It is made from an alcohol derivative that is obtained from the cooking and fermenting process of grain (usually corn). Most ethanol available is called E-85 and this is a combination of 85% ethanol and 15% gasoline. All Ford Taurus' manufactured after 1998 are E85 compatible.

Electricity

Electricity is used to power vehicles by an electric motor. The electricity is provided to the vehicle by batteries that store electricity. These batteries are re-charged every day (normally in the evening hours when the vehicle is not being used). The owner of an electric vehicle (EV) must re-charge the vehicle from home using a small re-charging station because, currently, no infrastructure for re-charging stations exists in North America. Only one state, California, has set-up re-charging stations in some areas. Therefore, EVs cannot be used for travelling long distances as there is difficulty in locating re-charging stations.

Hydrogen

Hydrogen as an energy source for vehicles is still being developed but is extremely promising. Hydrogen is a gas that can be created through electrolysis – the process of combing water and oxygen. Therefore, hydrogen is not only clean, it is also a renewable energy source (no fear of its

depletion). In a vehicle powered by hydrogen, hydrogen fuel cells are contained in the vehicle and are replenished with hydrogen, just as gasoline is replenished into the tank of a traditional vehicle. Consumers may even be able to fill up at home if an appliance that generates hydrogen is developed so that it is small enough and safe enough to store in a garage. No distribution system currently exists for hydrogen as a vehicular fuel source. This is because hydrogen powered vehicles are not being marketed to consumers at this time. The "Big Three" US auto manufacturers as well as the Japanese and Europeans are working to further develop and refine hydrogen powered automobiles. Once these vehicles are "consumer ready", there will be development of a hydrogen distribution system.

Should You Buy an Alternative Fuel Vehicle?

Most automotive companies are now manufacturing and selling alternative fuel vehicles. Since there are now different types of alternative fuels available, there are also a variety of vehicles designed to use a specific alternative fuel.

If you are in the market for a new car, it might be a good idea to check out the alternative vehicles that are currently available on the market. The following are vehicle types and their corresponding fuel:

1. Hybrids – Toyota Prius, Honda Insight
2. Compressed Natural Gas – Honda Civic, Ford Crown Victoria
3. Electric – GMEV1
4. E85 – Ford Taurus

The How, Where and What of Buying an Alternative Fuel Vehicle

For more information on buying natural gas vehicles please contact the Natural Gas Vehicle Coalition for the Natural Gas Buyer's Guide at 703-527-3022 or visit their Web site.

For more information on buying other types of alternative fuel vehicles please contact the U.S. Department of Energy Alternative Fuels Hotline at 1-800-423-1DOE or visit their Web site.

Did you know?

How You Drive Directly Affects the Amount of Pollution You Create:

One second of aggressive driving can create almost the same amount of carbon monoxide emissions as 30 minutes of regular driving.

For More Green Driving tips, please visit DOT's "It All Adds Up to Cleaner Air" information page.

Helpful Information Sources

Books:

Alternatives to Traditional Transportation Fuels: An Overview, by the Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels; U.S. Department of Energy, Washington, D.C., June, 1994.

Green Guide to Cars and Trucks: Model Year 1999, by John DeCicco and Martin Thomas; American Council for an Energy-Efficient Economy, Washington, D.C., 1999.

Paving the Way to Natural Gas Vehicles, by James S. Cannon; INFORM, New York, New York, New York, 1993.

Renewable Energy: A Concise Guide to Green Alternatives, by Jennifer Carless; Walker Publishing Company, New York, New York, 1993.

Organizations:

For general information on alternative fuels and alternative fuel vehicles, visit the U.S. Department of Energy's Alternative Fuels Information Sources or call the Alternative Fuels Hotline: 1-800-423-1DOE.

For general information on fossil fuel pollution, visit the U.S. Environmental Protection Agency Web site.

For specific information on CNG vehicles and Fueling Sites in Greater New York City, visit the Natural Gas Vehicle Coalition's Web site or call (703) 527-3022. All information is available directly from the Web site, but hard-copy NGVC publications can be requested (at no charge) for the following:

The 2000 U.S. Natural Gas Vehicle Fueling Stations
The 2000-2001 Natural Gas Vehicle Purchasing Guide