Racing Toward the Future: Alternative Fuel Vehicles in the 21st Century

by Elizabeth Knapp

One of the first electric vehicles ever made, the Rauch and Lang Electric Sedan was a huge hit when it entered the transportation scene in 1922. Now, more than 80 years later, the electric vehicle is making a comeback. Along with it, many new types of alternative fuel vehicles are appearing on America's roads and highways.

Why are automobile manufacturers and engineers taking another look at alternative fuel vehicles, or AFVs? One of the main reasons is air pollution. In many cities around the world, air pollution has reached extremely unhealthy levels and continues to climb. Fossil fuels burned in vehicles and power plants are by far the biggest source of air pollution. In addition, many countries, including the United States, do not have enough of the oil from which gasoline is made to meet their needs. As a result, they must depend on foreign oil supplies.

An AFV doesn't run on oil or gasoline. Instead, AFVs use alternative fuels, including alcohols, compressed natural gas, electricity, hydrogen, liquefied natural gas, liquefied petroleum gas, liquids made from coal, and biodiesel. Among the different types of AFVs currently being developed, the most promising and interesting are electric vehicles, hybrid vehicles, fuel cell vehicles, and hydrogen vehicles.

Electric Vehicles

Electric vehicles, or EVs, run on electricity stored in batteries instead of gasoline burned in an engine. Because they do not produce waste products such as carbon dioxide, EVs are considered zero-emission vehicles. An electric motor turns the wheels. Batteries, sometimes as many as 12 to 24, run the motor. For the batteries to be charged, the car must be plugged into a special charging unit, although some EVs can be plugged into a standard electrical wall outlet.

One of the biggest advantages of the EV is that it runs clean, without harmful emissions. Also, because the engine has fewer movable parts, it requires less service than gasoline engines and is far quieter. The biggest disadvantage of the EV is its limited driving range. An EV can only go about 100 miles before it must be recharged, which makes it inconvenient for long trips. There are, however, some EVs with special batteries that can go longer distances. For example, a company in Massachusetts designed an EV that set a world record for going 238 miles on one charge.

Right now, EVs are most practical for people who drive only a short distance to and from work or school or who simply need to get around the neighborhood. Cities are rediscovering the practical and environmental benefits of EVs for mass transit. Electric-powered buses, trolleys, subways, and trains are common methods of transportation around the world.

Hybrid Vehicles

Another major innovation in AFVs is the hybrid. Just as a *hybrid* is a mixture of two different things, a hybrid vehicle uses both gasoline and electricity for power, alternating between them. In many ways, hybrid vehicles combine the best of both worlds—lower emissions with great gas mileage.

While its primary power comes from the gasoline engine, a hybrid vehicle uses an electric motor to accelerate or climb hills. Unlike the batteries in an EV, the batteries in a hybrid do not need to be recharged. Recharging occurs automatically through *regenerative braking*. This means that the energy used during braking is captured and stored to recharge the batteries. At slower speeds, the hybrid runs on the electric motor. At higher speeds, it uses both the electric and gasoline motors, while recharging the battery.

Although the hybrid vehicle is becoming increasingly popular with today's drivers, many people feel that it is just a first step on the way to more advanced technologies. Because it is not a zero-emission vehicle like others that are being developed, some researchers believe that the hybrid will not have a lasting impact on the future of transportation.

Fuel Cell Vehicles

Like the EV, the fuel cell vehicle is a zero-emission vehicle. Fuel cells work by converting hydrogen and oxygen into water, producing electricity that powers an electric motor. For many years, fuel cells have been used to provide power on spacecraft, such as the space shuttle.

Fuel cells have two disadvantages. One is the lack of a system for distributing hydrogen and making it available at service stations. A second and greater challenge is the problem of how to store it. Hydrogen is a bulky gas. On the space shuttle, it is compressed and stored in huge fuel tanks. Such a storage method is not practical in cars, however.

Scientists are developing alternative methods to store hydrogen. One way is to compress the hydrogen in special high-pressure containers. Another is to separate it from hydrocarbon fuels such as methanol and gasoline through a device known as a reformer. A direct-methanol fuel cell also uses methanol, but it does not need a reformer to separate the hydrogen from the methanol. The hydrogen is removed from the liquid methanol inside the fuel cell itself.

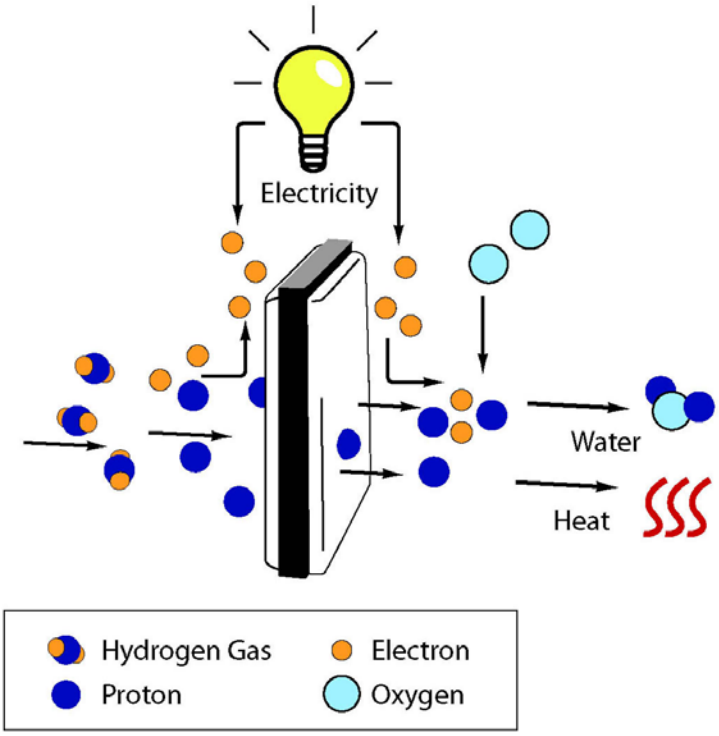
While the fuel cell vehicle has made great progress in recent years, at present, it remains a technology of the future. The few fuel cell vehicles in existence are used only for testing. Nevertheless, fuel cell vehicles are considered by many to be the most promising and realistic of AFVs.

Hydrogen Vehicles

Perhaps the most interesting and innovative of alternative vehicle fuels is hydrogen. Experts agree that hydrogen is the fuel of the future. It is easily obtained by splitting water into oxygen and hydrogen using electricity, and it emits almost no polluting gases when burned. The emissions that hydrogen does produce are free of carbon dioxide, since hydrogen is a non-carbon fuel.

Fuel cells are one method of using hydrogen to power a vehicle. Another is to burn the hydrogen directly in the engine, like gasoline. The same challenges are posed for these vehicles as for fuel cell vehicles: storage problems and the need for a distribution network. Hydrogen filling stations have begun appearing in several countries including the United States, and home fueling systems are being developed.

Hydrogen Fuel Cell



Conclusion

Since its appearance more than a century ago, the automobile has brought comfort and convenience to people's lives. Yet it remains the number-one source of air pollution in the world. Alternative fuel vehicles offer a means of reducing pollution significantly. In addition, many AFVs are fuel-efficient and economical to operate.

For these reasons, a growing number of major cities and businesses are putting AFVs in their vehicle fleets. Government at all levels offers tax incentives for purchasing them. Major auto manufacturers already market AFVs, and more are being developed. Alternative fuel vehicles are the wave of the future.

To Fuel or Not to Fuel

by Elizabeth Knapp

In January 2003, the U.S. government introduced a plan that proposed spending $1.7 billion on the development of hydrogen-powered fuel cells, a distribution network that would make hydrogen as widely available as gasoline, and technologies for mass-producing fuel cell vehicles. In many ways, this plan is the most ambitious and aggressive new clean-energy program to date. However, the circumstances surrounding the need for such a program are not new.

Cars and trucks emit many harmful pollutants that can cause serious health problems. These pollutants deplete the earth's protective ozone layer. They also produce smog and acid rain. Scientists believe that the carbon dioxide emitted by gas-powered cars and trucks contributes to global warming, an increase in the average temperature of the earth's surface caused mainly by human activities. Global warming is driving changes in the earth's climate that could threaten people's health. It could also harm fish, birds, and many kinds of ecosystems and affect water supplies, crops, and forests.

Furthermore, America's reliance on foreign oil imports, like those from the Middle East, weakens our country's energy security. According to the U.S. Department of Energy (DOE), the United States depends on foreign oil for more than half its current energy needs. In addition, the United States accounts for 25 percent of oil use in the world, yet it has just 2.2 percent of the world's oil reserves. These facts point to the need for immediate solutions to growing energy problems.

Several countries, including the United States, Germany, and Iceland, are turning to hydrogen-powered fuel cell vehicles as the future's answer to the clean-running car. Fuel cells combine hydrogen with oxygen from the air. In the process, they generate electricity, which is used to power the vehicle. A fuel cell vehicle is the ultimate clean car because it emits only water as a waste product.

While fuel cell vehicles are a very promising technology, they may not be ready soon enough to provide an answer for current energy problems. Auto manufacturers predict that fuel cell vehicles will not be widely available until 2010 at the earliest. In the meantime, experts believe there are other, more immediate ways of reducing harmful pollutants, as well our reliance on foreign oil supplies.

One very obvious way is for the government to mandate that auto manufacturers increase fuel efficiency for their cars. With more miles to the gallon, cars would use less gasoline. Another way is for the government to tighten emissions standards. This would require auto manufacturers to produce cars that emit fewer pollutants.

While fuel cell vehicles are certain to be an important part of the solution to the world's energy problems, they are only a part. Ultimately, the question is whether to fuel or not to fuel—how much to spend and where to spend it. The DOE estimates that by 2020, U.S. oil consumption will rise more than 40 percent. At the same time, the number of cars on the road will increase from 600 million to 1 billion. By then, will there be enough oil to produce the gasoline that powers our cars, and clean air for us to breathe?