A Sustainable Environment: Our Obligation to Protect God's Gift

by

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Is Hydrogen the Answer to Our Energy Problems?

We all know that we are heading to a shortage of energy sources, particularly that of oil. As it is our most important source of energy for transportation, there have been many recommendations as to how we can mitigate this problem. While Congress is recommending more exploration for oil and an increase in production of gasoline, many others and I are recommending conservation as the better way to solve the problem. Another alternative is the development of hydrogen as the eventual replacement for gasoline in the fueling of automobiles, trucks and buses. But exactly what is its potential and what are the disadvantages?

Hydrogen is the most abundant element in the universe, but it is not really an energy source like oil and coal because it is almost never found in its pure form. It must be released from chemical compounds using heat (energy) and catalysts. One method is to separate the oxygen and hydrogen from water by using electricity, a process known as electrolysis. Unfortunately, it is very expensive and not very efficient. A more efficient method is to remove hydrogen from hydrocarbons, such as natural gas, by "reforming". This is the most common method used today and over five percent of the U.S. natural gas output is currently converted to hydrogen.

As mentioned above, it takes energy to separate the hydrogen and oxygen in water. As chemical reactions are reversible, the combination of hydrogen and oxygen will **produce** energy and water. This is the process used in an energy device known as a fuel cell. The most important aspect of this entire process is to produce hydrogen very economically. It doesn't make sense to use more energy to produce hydrogen than the energy that is derived from hydrogen.

When looking at alternative fuels for an application such as transportation, the overall efficiency is extremely critical. Converting oil to gasoline is about 88% efficient, meaning you lose about 12% of the energy potential in the manufacturing of gasoline. However, from the gas tank to the car wheels, the process is only about 16% efficient. So the overall efficiency going from oil wells to car wheels is about 14%. For hybrid cars this overall efficiency increases to about 26% because of the higher tank-to-wheels efficiency. With a fuel cell driven automobile, the tank-to-wheels efficiency is about 60%. So even though the conversion of natural gas to hydrogen is only 70%, compared to the 88% for oil to gas, the overall efficiency is 42% (60% times 70%), which is almost three times greater than a gasoline powered car.

Some people are concerned using hydrogen because it is considered too volatile and explosive. They have heard of the 1937 Hindenburg disaster when the dirigible caught fire. In a recent investigation of that accident, it was determined that none of the

33 people that died was killed by the hydrogen fire, but rather by jumping out or by the burning of the diesel fuel or other combustibles on board. The clear hydrogen flames swirled harmlessly above the 62 surviving passengers as they rode the flaming blimp safely to earth.

Another concern with using hydrogen is how to distribute it throughout the country to hydrogen filling stations. Would we have to build new pipelines and what would we do with the existing pipelines? In general, the existing pipelines could be converted by adding polymer-composite liners. In addition, the compressors for moving the product through the pipes could also be converted. However, it might make more sense to transfer natural gas to the filling station and equip each filling station with a reformer to produce the hydrogen.

But then, each automobile must store hydrogen. Is this a problem and how safe is it? Tanks that can safely store hydrogen have already been produced but, for the same driving range, are larger than gasoline tanks. This is because hydrogen is so much lighter than gasoline, even under pressure.

If all of the perceived problems with a hydrogen-powered automobile are not really problems at all, why don't we have fuel cell cars now? Demonstration vehicles have been successfully operated and more will be seen in the near future. A few years ago, the Chicago Transportation Authority (CTA) operated a few buses running on fuel cells. It has been predicted that it will be another ten to fifteen years before we see mass produced fuel cell automobiles. However, Honda just announced that it plans a production model within the next three to four years.

Going to a hydrogen economy for transportation fuel has two major benefits. It will reduce, or even possibly eliminate, our dependence on oil. But even more important, switching to hydrogen will have a significant reduction in the effects of global warming. In the U.S., transportation accounts for over 30% of the carbon dioxide contributing to global warming. Instead of producing carbon dioxide when combusting gasoline, the output from a fuel cell is only water. For more information about advances in fuel cells for automobiles, you may wish to visit the website of Rocky Mountain Institute at www.rmi.org. I also recommend you see a documentary released last month called "Who Killed the Electric Car". It may still be at the theaters, but if it isn't you should be able to see it soon on DVD.