

## Straight Answers on Alternative Fuels

### What Is Hydrogen?



Hydrogen gas ( $H_2$ ) is the simplest and lightest fuel. Hydrogen exists in a gaseous state at atmospheric pressure and ambient temperatures. Hydrogen gas may contain low levels of carbon monoxide and carbon dioxide, depending on the production source. Hydrogen is being explored for use in combustion engines and fuel cell electric vehicles. On a volumetric basis, the energy density of hydrogen is very low under ambient conditions. This presents greater transportation and storage hurdles than for liquid fuels. Vehicle storage systems being developed include compressed hydrogen, liquid hydrogen, and physical or chemical bonding between hydrogen and a storage media (for example, metal hydrides).

Hydrogen will likely play an important role in developing sustainable transportation in the United States, because in the future it may be produced in virtually unlimited quantities using renewable resources. Hydrogen use has been demonstrated in a number of internal combustion engine vehicles. In addition, hydrogen is being used in a growing number of demonstration fuel cell vehicles. Hydrogen and oxygen from air fed into a proton exchange membrane (PEM) fuel cell "stack" produce enough electricity to power an electric automobile, without producing harmful emissions.

### How Is Hydrogen Made?

Hydrogen is the most abundant element in the universe and can be found on Earth in virtually unlimited quantities. It can be produced from a variety of domestic resources that contain hydrogen including fossil fuels, such as natural gas and coal, and even water. The process typically used for producing hydrogen from fossil fuels is called steam reformation, while the process for dissociating water into hydrogen and oxygen is called electrolysis. The energy requirements for producing hydrogen from these processes is significant, so a variety of energy sources can be used including nuclear power and renewable energy technologies, such as wind, solar, geothermal, and hydro-electric power. Researchers are working to develop a range of technologies and processes to produce hydrogen economically and in environmentally friendly ways.

The ability to create hydrogen from a variety of resources and its clean-burning properties make it a desirable alternative fuel. There is currently no significant distribution infrastructure for hydrogen use as a transportation fuel. For significant market penetration, this infrastructure will need to be developed for both regional and national use. For the time being, hydrogen can be found in small quantities for fleet demonstrations and in a handful of retail locations nationally for supporting local fleets.

### What Vehicles Can Use It?

The hydrogen market has great potential for transportation applications. However, there are currently no commercially available vehicles for the general public. Experts estimate that it will take another 10-20 years before hydrogen vehicles, and the infrastructure to support them, will become a significant portion of the marketplace. At this time, the government and industry are working to overcome technical and cost barriers.

Although they are still in development, hydrogen vehicles represent an attractive option for reducing petroleum consumption and improving air quality. If fueled with pure hydrogen, fuel cell vehicles (FCVs) emit only heat and water as a byproduct. Hydrogen FCVs are currently being demonstrated in light- and heavy-duty applications in fleets throughout the country. Honda has placed several prototype light-duty FCVs in city fleets, California transit agencies are demonstrating fuel cell buses in revenue service, and General Motors has announced a nationwide demonstration involving 100 FCVs.

The U.S. Department of Energy (DOE) is dedicated to hydrogen vehicle research and development. From using hydrogen in internal combustion engines to building a nationwide network of hydrogen refueling stations, research in all aspects of hydrogen vehicle use are being conducted by DOE's FreedomCAR and Vehicle Technologies and Hydrogen, Fuel Cells, and Infrastructure Technologies (HFCIT) Programs.



## Why Should We Use It?

Widespread use of hydrogen as an energy source in this country could help address concerns about energy security, global climate change, and air quality. Fuel cells are an important enabling technology for the hydrogen future and have the potential to revolutionize the way we power our nation, offering cleaner, more efficient alternatives to the combustion of gasoline and other fossil fuels. Hydrogen's main benefits are: stronger national energy security, reduced greenhouse gas emissions, improved air quality and increased energy efficiency.

## Where Can I Get It in Maryland?

There are 31 hydrogen fueling stations in the U.S.; however, all but five are private stations being used for demonstration projects. Another 17 are in the planning process. Currently, the only hydrogen fueling station in the Baltimore Washington Metropolitan Area is located on Benning Road in Washington, DC and is not open to the public. Another station is planned for Fort Belvoir, VA. The U.S. Department of Energy maintains a database of regional alternative refueling stations (including hydrogen) at <http://www.eere.energy.gov/afdc/infrastructure/locator.html>.



## What is the State Doing for Hydrogen Use?

Maryland Energy Administration has partnered with General Motors to educate students about the benefits of hydrogen technology in transportation. Representatives are available to make classroom visits and to bring GM's HydroGen3 Fuel Cell vehicle to schools. Middle school and high school teachers are invited to email [lrobbins@energy.state.md.us](mailto:lrobbins@energy.state.md.us) for more information on this exciting learning opportunity.

## What is the Federal Government Doing for Hydrogen Use?

Section 1341 of the Energy Policy Act of 2005 provides a base tax credit of \$8,000 for the purchaser light-duty fuel cell vehicles (<8,501 lb GVWR). The \$8,000 credit is valid until December 31, 2009. After that, the credit is \$4,000. To qualify, the vehicles must meet at least Bin 5 Tier II emission levels. Base tax credits are also available for medium- and heavy-duty fuel cell vehicles. The credit is available until December 31, 2014. For tax-exempt entities, the credit can be passed back to the vehicle seller.

Section 1342 of the Energy Policy Act of 2005 provides a tax credit equal to 30% of the cost of the alternative fuel refueling property, up to \$30,000 for business property. The credit expires in 2014. Buyers of residential refueling equipment can receive a \$1,000 tax credit. For non-tax-paying entities, the credit can be passed back to the equipment seller.

## Where Can I Find More?

For more general information on hydrogen and fuel cell vehicles, you can visit California Fuel Cell Partnership:

<http://www.fuelcellpartnership.org>

Or the U.S. Department of Energy:

<http://www.eere.energy.gov/afdc/altfuel/hydrogen.html>

<http://www1.eere.energy.gov/hydrogenandfuelcells>

For more information on the Maryland Clean Cities Program and how you can help:

<http://www.energy.state.md.us/programs/transportation/cleancities/index.html>

