

# Hydrogen & Fuel Cells

## A Primer on Hydrogen and Fuel Cell Technology

Excerpt from *Powering Our Future: An Energy Sourcebook for Sustainable Living*. The text was modified to fit the Web site.

Hydrogen is the lightest, as well as the most abundant element in the universe. Although this single-proton atom is ubiquitous, its colorless and odorless characteristics make it imperceptible to the senses. On earth, it is a main component of water, fossil fuels, organic matter, and many other natural compounds. Hydrogen readily bonds to other elements, so it is rarely found in its pure form. To use hydrogen as a fuel, it must be extracted from another substance, such as water or natural gas. For this reason, hydrogen is considered an energy carrier as opposed to an energy source. However, it does effectively serve as a medium for storing and transferring energy from a source to an electric current.

Used for a diversity of industrial purposes, there is already a well-established hydrogen production industry. Unfortunately, worldwide, 96 percent of hydrogen is produced from nonrenewable sources. Using conventional methods, deriving hydrogen from fossil fuels carries essentially the same problems associated with hydrocarbon combustion. When acquired from clean, renewable sources, however, it can provide an inexhaustible supply of energy with minimal impact on the environment. According to the American Solar Energy Society (ASES), "Hydrogen, generated by renewable energy resources, is the most sustainable, secure, healthy, economic, environmentally friendly, and socially compatible new energy option." While there are numerous hurdles that still remain for the industry, many experts are convinced that the end of the petroleum age will give rise to the dawn of the hydrogen economy.

In order to harness the energy in hydrogen, a fuel cell is required. A fuel cell is similar to a battery that never needs recharging as long as hydrogen is fed into the fuel cell. The byproducts of fuel cells are only water and sometimes trace amounts of nitrogen oxides. There are few applications where fuel cells are not feasible candidates. Unlike electricity, hydrogen offers the advantage of being relatively easy to store. As a result, many applications that currently employ a battery storage system may eventually turn to hydrogen to provide a reliable and efficient source of stored energy. Fuel cells have the potential of providing virtually all of society's energy needs, including transportation, power generation, temperature regulation, and micro applications such as cell phones.

Hydrogen is an extremely enticing energy option for a clean, sustainable energy future. However, as corporations and governments pour billions of dollars into developing hydrogen and fuel cell technology, uncertainties linger regarding the economic and technical feasibility of this emerging industry. Fuel cell technology is here, but its debut in mainstream society remains on the horizon for several reasons: First, fuel cells are still many years from large-scale commercial implementation. However, if this emerging industry were to receive some of the tax incentives currently available to the fossil fuel industry, we could significantly speed commercial implementation. Second, the hydrogen industry is only as clean and sustainable as the sources and processes used to produce hydrogen. The current practice of producing hydrogen from polluting, nonrenewable fossil fuels may be suitable in the short-term, but in the long-term we need to produce hydrogen from renewable sources if we desire to attain a clean and sustainable energy future. Ultimately, a full commitment to developing economical methods of extracting hydrogen from renewable sources is essential. While it would be dangerous to rely excessively

on unproven fuel cell technology to solve future challenges, the anticipated hydrogen economy offers our best opportunity, at present, to create a healthier and more stable global energy future. While transitioning from a fossil fuel driven economy to a hydrogen economy, increasing energy efficiency and implementing conservation measures can reduce environmental impacts as we move toward a clean and renewable energy future.

## **Sources**

Lovins, Amory, Twenty Hydrogen Myths, Rocky Mountain Institute, June 20, 2003. This position paper on the emerging hydrogen economy was corrected and updated on September 2, 2003. Lovins is the cofounder and CEO of the Rocky Mountain Institute. He has published 28 books in addition to hundreds of articles.

[http://www.ases.org/about\\_ases/press/Hydrogen10\\_1\\_03.htm](http://www.ases.org/about_ases/press/Hydrogen10_1_03.htm), accessed November 13, 2004. American Solar Energy Association posted a press release entitled "Scientists call for Major Renewable Hydrogen Initiative as America's Clean and Affordable Answer to Dirty Air, Blackouts, Rising Gas Prices and Foreign Oil Dependence." It was posted on October 1, 2003. ASES is committed to supporting the betterment of U.S. citizens and the environment through the promotion of solar energy and other renewable sources.

Heinberg, Richard, The Party's Over: Oil, War and the Fate of Industrial Societies, Gabriola Island: New Society Publishers, 2003, p. 148.