



Hydrogen: Clean, Alternative Energy For Use Today

Over the centuries, mankind has moved from finite energy sources of wood, coal, petroleum, and natural gas to vaster energy sources of nuclear power, and renewable wind, solar, and biomass. We are now moving into the hydrogen era.

Every energy source in history has one thing in common: each contains hydrogen. The first element in the Periodic Table, it is the lightest and most abundant element in the universe. A colorless, odorless gas, hydrogen is found in water and all organic compounds. Like other cleaner, renewable energy sources, hydrogen use reduces dependence on foreign oil, is environmentally friendly, and creates new jobs and technologies as it emerges as an alternative energy sector.

Because hydrogen bonds easily with other elements, it must be extracted from compounds. Of the 50 million tons of hydrogen produced around the world each year, a majority comes from water. Energy to produce hydrogen from water is provided by a variety of sources, including natural gas, petroleum, and coal. Hydrogen is also produced directly from these energy sources. As technology lowers production costs, renewable hydrogen sources will come to the forefront, including wind, solar, hydro, geothermal, and biomass, resulting in zero pollution or greenhouse gases. Nuclear power may be a cost-efficient method of extracting hydrogen from water through electrolysis.

For transportation, hydrogen can be burned in an engine or used in a fuel cell:

- **As a fuel:** Hydrogen is about 30% percent more efficient than gasoline when burned in an engine. Hydrogen engines do not emit carbon dioxide.
- **In a fuel cell:** Hydrogen acts as an energy carrier in a fuel cell. The fuel cell is 100% to 200% more efficient than gasoline and the only byproduct is clean water.

According to the U.S. Department of Energy, the energy production cost for an automotive fuel cell is now about \$95 per kilowatt, and is projected to improve to \$60 per kilowatt in 2009. The target is to reach \$30 per kilowatt by 2015. The estimated energy cost for a gasoline engine is currently about \$50 per kilowatt.

Hundreds of hydrogen cars are already on the road worldwide. BMW, Honda, and General Motors rolled out their first commercial vehicles this year: BMW's Hydrogen 7 burns hydrogen as fuel; Honda's FCX Clarity is a fuel cell vehicle, as are Chevrolet's Sequel and Equinox models.

Commercial scale generation units powered by hydrogen fuel cells are providing continuous, reliable electricity and heat to schools, commercial buildings, and homes, as well as remote and backup power for emergency response.

Major industrial uses of hydrogen include making ammonia for fertilizer, removing sulphur from gasoline, chemical processing, and production of methanol and refined metals. It is also used in production of vitamins, cosmetics, semiconductor circuits, soaps, lubricants, cleaners, and even margarine and peanut butter. It is perhaps best known for its use as rocket fuel.

