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Fuel Cell Vehicles

The fuel cell vehicle has long been viewed as the Holy Grail in automobile research. These cars would be powered by the chemical reaction of hydrogen and air. They wouldn't produce any of the environmentally dangerous bi-products produced by today's fossil-fueled vehicles. Only clean water vapor would spew from their tailpipes.

Since the turn of the century, Toyota, Honda, General Motors, Ford and other vehicle manufacturers have all worked feverishly to bring this technology to the open road. They all hope to ramp up production by the end of this decade.

They all still need to test the reliability of their vehicles under normal driving conditions and also build the infrastructure for hydrogen refueling stations. You can't bring the cars to market without the fueling stations needed to keep their electric motors humming on the electricity they produce from hydrogen.

In 2007, General Motors will launch "Project Driveway." This program will place 100 fuel cell vehicles in the hands of government employees to determine how the cars handle normal, day-to-day driving conditions on the roads of Washington, DC; California; and New York.

Honda produced the first fuel cell vehicle certified by the U.S. Environmental Protection Agency for public road use, and the company's fuel cell technology seems a little ahead of the pack. In 2005, Honda leased its first FCX fuel cell vehicle in California. Since a car without a refilling station wouldn't make much sense, Honda also set up an experimental home refueling facility that not only produces hydrogen for the car but also electricity and heating for the homeowner.

A fuel cell car is basically an electric hybrid that receives its power directly from the electricity produced by the vehicle's fuel cells. The new Honda FCX has a 148-pound vertical-flow-designed fuel stack. This design is 20 percent smaller than the 230-pound design found in Honda's previous FCX models. Its size allowed the manufacturer to place it between the front seats of the vehicle in a middle console tunnel once reserved for a transmission shift lever on fossil-fuel vehicles. (See photo.)

Photo courtesy of American Honda Motor Co.

Cutaway view shows fuel-cell components beneath console and rear seat areas.

The FCX stores hydrogen in two corrosion-resistant, three-layered, high-pressure tanks located under the vehicle's rear seats. The passenger cabin is completely isolated from the hydrogen. Special sensors, a forced ventilation system and multiple shut off valves will shut off the flow of hydrogen and electricity in the event of a leak or collision.

Honda has designed the vehicle's frame to withstand multiple collisions from every direction. The company has made the refueling system as idiot proof as possible—definitely safer than our current method of refueling a fossil-fuel-powered car. The FCX can travel 300 miles on a single hydrogen fill-up. Current fuel cell efficiencies produce the energy equivalent of one gallon of gasoline from each kilogram of stored hydrogen. As this technology matures, fuel efficiency should improve.

Fuel from the hydrogen tanks is fed to the fuel cell stack to generate electricity to drive the electric motors. The car stores extra generated electricity in its ultra-capacitor. Regenerative braking also adds to the energy stored in the ultra-capacitor.

As in other hybrids, driver demand determines power to the wheels. The vehicle's onboard computers determine the amount of power needed, along with the mix of power from the fuel cell and the ultra-capacitor needed to deliver the electricity to the three motors that power the wheels. The car's drive train has one motor to power the front wheels and separate motors to power each of the back wheels.

Of all current fuel cell vehicles, the Honda design is the most aerodynamically efficient—and less wind resistance means more miles per kilogram of stored hydrogen. Honda even coined a new word to describe its new environmentally friendly technology: *environmentology*.

Recalling the Facts

1. Describe "Project Driveway."
2. How do the fuel cell and the ultra-capacitor work together to create or store and transmit power to the wheels?
3. What safety systems have been designed into this vehicle to protect occupants in case of a hydrogen leak or auto accident?

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.