Maryland Department of the Environment

FACTS ABOUT:
FUEL CELL VEHICLES

What is a fuel cell vehicle?

A fuel cell vehicle uses a fuel cell stack to produce electricity through chemical reactions. The most common fuel source, hydrogen, is mixed with oxygen to produce electricity, generating only water and heat as byproducts. The electricity then powers an electrical motor much like an electric vehicle. However, an electric vehicle runs off of electricity from a battery, which has a limited storage capacity. The key difference of a fuel cell over an EV is that in fuel cells the stored chemicals can be replenished quickly through refueling, quite similar to today's conventional gas engine vehicles. Fuel cells are still a new and expensive technology, and are therefore not available in all markets. Currently the infrastructure for refueling fuel cell vehicles is not adequate enough for widespread distribution across the country. Given that hydrogen is the most abundant element on the planet it makes sense to try and use its energy capabilities to power the future. With future advancements in fuel cell technology, and hydrogen production, this could prove to be a viable alternative to fossil fuels.

How do fuel cells work?

Hydrogen fuel cell vehicles work through an electrochemical process where stored hydrogen, either compressed or in liquid form, mixes with oxygen to produce electricity. This electricity then powers an electric motor to propel the vehicle. Some fuel cell vehicles include a battery to store energy generated from regenerative braking in an effort to help supply supplemental power to the electric motor. The hydrogen fuel can be replenished through fuel stations by pumping compressed or liquid hydrogen into a pressurized storage tank. This ability means fuel cell vehicles can refuel in a similar manner to conventional vehicles. This eliminates concerns over 'range anxiety' caused by purely electric vehicles. The only byproducts of combining hydrogen and oxygen to produce electricity are heat and water. This greatly helps reduce harmful emissions caused by today's vehicles and reduces CO_2 output from mobile sources.

Benefits

- Zero harmful emissions from the vehicle while operating. Heat and water are the only byproduct of hydrogen fuel cells.

- Reduced CO_2 emissions from mobile sources will help alleviate concerns of global warming.
- Hydrogen gas can be derived from natural gas and coal, reducing dependence on foreign oil.
- Ability to refuel relieves 'range anxiety' associated with electric vehicles.
- Similar infrastructure would be needed to refuel that is used in today's vehicles. Adding hydrogen pumps at gas stations or building independent stations would make transitioning to fuel cells easier compared to other technologies.
- Refueling a fuel cell requires a comparable time to refueling a conventional gas tank, unlike recharging a battery which can take hours.
- Fuel Cell vehicles operate much quieter and smoother than conventional engine vehicles.

Disadvantages

- Cost- fuel cell vehicles are too expensive to compete with hybrids and conventional vehicles at this time. It will be years before fuel cell vehicle cost will be brought down to acceptable consumer levels.
- Limited availability- fuel cells are currently only available in select markets like Southern California, and are restricted to areas where fueling stations are available.
- Hydrogen storage is currently an issue. In order for vehicles to stay small and lightweight the hydrogen storage tank's size must be limited. This reduces storage capacity and causes the range of the vehicles to be around 200 miles on a full tank vs. 300 for conventional vehicles.
- While the transition to hydrogen pumps should be relatively simple, building refueling stations across the nation will take time. This will reduce consumer appeal until the proper infrastructure is in place.
- Other technologies are more appealing in terms of cost, reliability, and performance. This can decrease interest in fuel cells resulting in less research and development into the technology.
- Hydrogen must be compressed in order to have an acceptable energy density for use in fuel cells. If fossil fuels are used to compress the hydrogen then harmful pollutants could still be emitted into the atmosphere, reducing the positive effect fuel cells have on the environment.