Frequently Asked Questions

The California Fuel Cell Partnership is a unique collaborative of auto manufacturers, energy companies, fuel cell technology companies and government agencies.

INTRODUCTION

To reach California's goals for cleaner air and reduced greenhouse gases we need full-function cars, pickups, vans and SUVs that people want to drive and transit buses they want to ride. These vehicles must be comparable or better than the vehicles we are driving today, and be better for the environment.

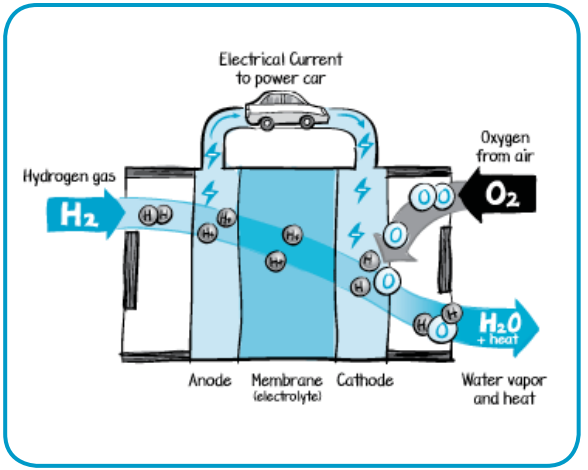
We believe hydrogen-powered fuel cell vehicles are the best option for fulfilling this promise.

FREQUENTLY ASKED QUESTIONS

1. How is a fuel cell different than a battery?
2. How efficient is a fuel cell?
3. Is the H_2 a liquid or gas?
4. Why not make the H_2 onboard the vehicle?
5. What do hydrogen stations look like?
6. What happens when the fuel cell wears out?
7. How does a fuel cell vehicle perform?
8. How can I get one?
9. What can I do to move this along?
10. What does CaFCP do?
11. Why make the investment now?

QUICK ANSWER

A battery stores energy and a fuel cell creates electricity from energy stored in a fuel tank.



LONG ANSWER

A fuel cell has an anode, a cathode and a membrane coated with a catalyst. The membrane is the electrolyte. The reactants (hydrogen and oxygen) are stored externally. Hydrogen enters the anode side of the fuel cell and oxygen enters from the cathode side.

#1

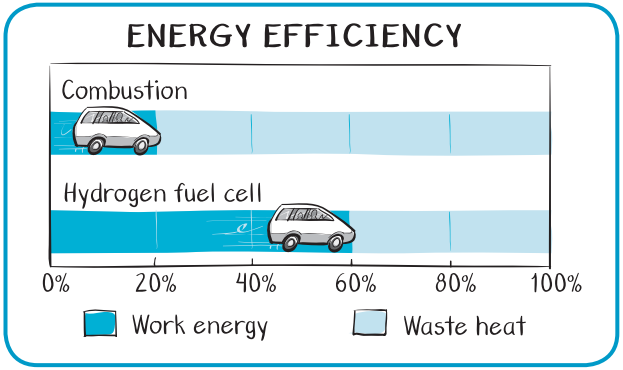
QUESTION:
How is a fuel cell different than a battery?

When the molecules come into contact with the catalyst, the reaction begins and creates an electric current. A fuel cell will create electricity as long as it has fuel, but when the fuel supply is shut off, the fuel cell doesn’t create a current. The hydrogen in the fuel tank never loses any of the stored energy.

A battery has an anode and a cathode, usually made of metals, and an electrolyte that allows a chemical reaction to occur. A charged battery stores chemical energy. During discharge, a chemical reaction releases electrons through an external circuit, providing useful electricity. Some types of batteries can be recharged, which reverses the chemical reaction and allows energy to be stored again in the battery. Over time, batteries are capable of storing less energy each time they are recharged. Even when batteries are sitting idle they lose some stored energy.

QUICK ANSWER

Fuel cell vehicles are 2-3 times as efficient as conventional combustion engine vehicles.



LONG ANSWER

As energy transfers from one system to another, some energy becomes "work" and some becomes "waste." In a vehicle, work energy provides power and waste energy becomes heat. Efficiency is a measure of the amount of work energy from the fuel. A fuel cell is about 60% efficient. A fuel cell uses energy from a chemical reaction

#2

QUESTION:
How efficient is a fuel cell?

and has no moving parts. In a vehicle, the fuel cell powers an electric motor, which is also very efficient in converting the energy from the fuel cell into work.

A combustion engine is about 25% efficient when using gasoline. (The efficiency is slightly greater with diesel and E85.) An engine uses energy created by burning fuel. Quite a bit of the energy is waste heat from combustion, and friction from moving engine parts creates even more waste heat.

INTERESTING FACT

- The Department of Energy's target for fuel cell efficiency is 60%. DOE reports that efficiency is currently 53-58%.

#3

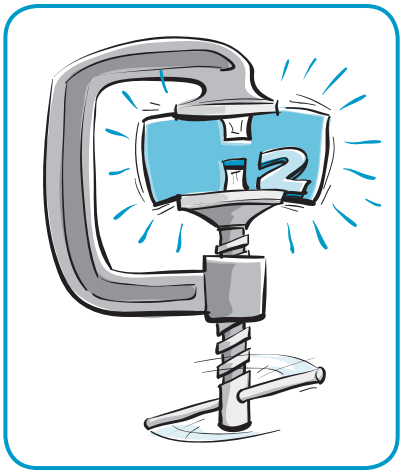
QUESTION:
Is the H_2 a liquid or gas?

QUICK ANSWER

Fuel cell vehicles use gaseous hydrogen.

LONG ANSWER

Fuel cell vehicles carry their hydrogen in a gaseous state. At normal temperatures, hydrogen is a gas. A kilogram of gaseous hydrogen fills more space than a kilogram of liquid hydrogen.



One way to extend the range of a vehicle is to increase the amount of fuel it holds. With hydrogen, it may seem obvious to use the fuel in a liquid state.

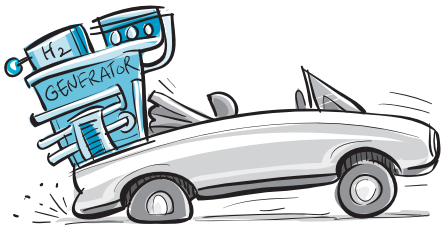
It’s not that straightforward, though. To be a liquid, hydrogen must be at -423°F (-25°C). If the hydrogen warms up even a little, it begins to evaporate. The tanks to hold hydrogen at a cryogenic temperature would have to be thick and even heavier than the tanks that hold gaseous hydrogen. At the station, the fueling equipment would have to be well insulated, too, making it thick and heavy.

INTERESTING FACTS

- Some FCVs carry hydrogen compressed at 5,000psi (35MPa)—about the same as a paintball gun. Others carry hydrogen at 70MPa.
- Longer term, storing hydrogen as a solid may be an option. A hydride stores molecules of hydrogen between the molecules of metal, like a sponge stores water in its pores.

QUICK ANSWER

It's possible, but not practical.



LONG ANSWER

Early in CaFCP's history, some automakers looked at reforming gasoline or methanol into hydrogen onboard the vehicles. Both processes worked, but added weight, complexity and cost to the vehicle. It's easier and more cost effective to produce the fuel at a central location.

#4

QUESTION:
Why not make the H_2 onboard the vehicle?

A quick search of the web shows a number of devices that claim to increase a combustion engine's mileage by generating hydrogen and then mixing the hydrogen in with the gasoline.

Some of these devices are billed as "hydrogen fuel cells." Science has not proven that these devices work and the automakers do not endorse adding any device that is not factory certified to your vehicle.

INTERESTING FACTS

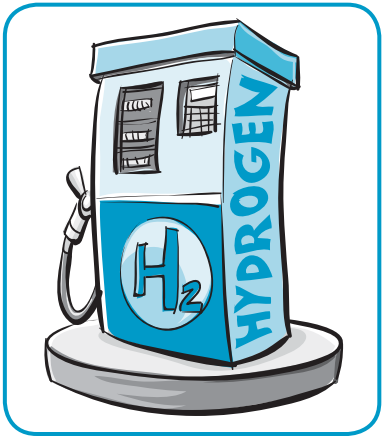
- The world produces hydrogen equivalent to 56 billion gallons of gasoline, enough to fuel 180 million fuel cell vehicles.
- 53% of the hydrogen produced in North America is already dedicated to transportation, enough to fuel 21 million FCVs. It's used to make gasoline cleaner by removing sulfur from petroleum at refineries.
- A large hydrogen production site exists today near almost every major U.S. and European city.

QUICK ANSWER

Hydrogen stations look similar to gasoline stations.

LONG ANSWER

Like a gasoline station, a car pulls up to a dispenser that sits on an island. Fueling the car is similar to filling a vehicle with natural gas, or to putting propane in a barbecue tank. It's a quick and simple process.



Like a gasoline station, hydrogen stations store fuel on site. Gasoline stations store the fuel in huge tanks underground. Tanker trucks regularly fill the gasoline storage tanks and vent stacks allow evaporating gas fumes to escape.

#5

QUESTION:
What do hydrogen stations look like?

Hydrogen stations also store fuel on site. Some stations have a large tank that stores liquid hydrogen that is delivered by a tanker truck. The liquid is warmed to a gaseous state and compressed before dispensing into the vehicle. Other stations produce the fuel onsite, so the station consists of the production equipment as well as the storage and dispensing equipment.

Most hydrogen stations store fuel in above-ground tanks. The style and placement of the tanks differs from station to station. Most of the stations in California dispense only hydrogen, one station has hydrogen and sells gasoline. Other companies are considering stations that offer several alternative fuels, like E85, natural gas and hydrogen.

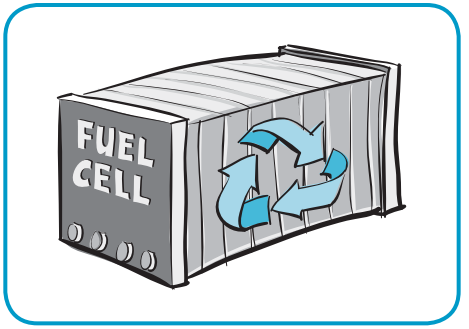
Hydrogen station design is new territory and still evolving. Visit CaFCP's website to see pictures of California's hydrogen stations.

#6

QUESTION:
What happens when the fuel cell wears out?

QUICK ANSWER

They won't wear out during the life of the vehicle.



LONG ANSWER

The fuel cells are being designed to last the lifetime of the vehicle, about 150,000 miles. As with vehicles and drivers today, some people will get more than 150,000 miles and some will get less. The automakers assume that, like today, when the vehicle reaches 150,000 miles most people will trade in their fuel cell vehicle for a newer model. It may be that some people choose to replace the fuel cell, just as some people choose to replace the engine in a conventional car.

All the components in a fuel cell are recyclable. At the end of its lifespan the fuel cell will be disassembled and the materials recycled, similar to what happens with vehicle components today.

INTERESTING FACTS

- Fuel cells use a thin layer of platinum as the catalyst for the hydrogen/oxygen reaction. It's about three times as much platinum as in a catalytic converter in a conventional vehicle.
- All platinum used in vehicles (including fuel cells) is recycled material.
- Reducing the platinum content of a fuel cell substantially reduces the cost. Ongoing research has made great progress towards this goal.

QUICK ANSWER

Great!

LONG ANSWER

In most respects, a fuel cell vehicle drives like a conventional vehicle. It has power and performance—great pick-up and easily cruises at freeway speeds. Inside the vehicle, it has all the space and comfort you'd expect. The dashboard gauges are different, displaying percentage of fuel remaining, kilowatts instead of RPM, and power management.

#7

QUESTION:
How does a fuel cell vehicle perform?

Driving or riding in an FCV, you do notice a few differences. First, you won't feel the vehicle change gears when accelerating or climbing hills. FCVs have electric motors and no transmission, so it's smooth driving all the way. Second, it's very quiet. Fuel cell vehicles have no engine or moving parts, so they make very little noise. You especially notice the quietness when riding in a fuel cell bus or driving a passenger vehicle on the highway with the windows down.

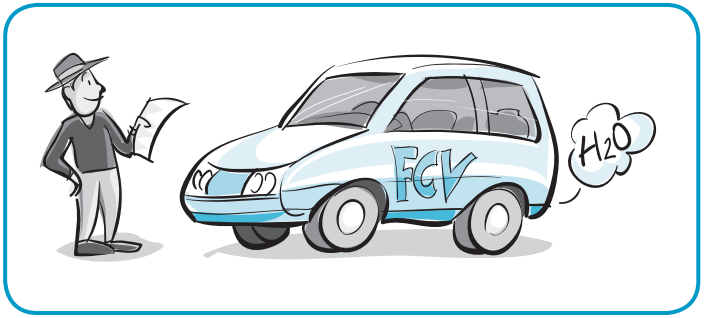
INTERESTING FACT

- Street traffic is the largest contributor to noise pollution. An average automobile operates at 67-75 decibels, diesel buses operate at 100 dB. Fuel cell passenger vehicles and transit buses operate at 50-60 decibels, about the same level as a refrigerator, a gentle breeze or an ordinary spoken voice.

QUICK ANSWER

It will be a few years yet.

LONG ANSWER



Fuel cell vehicles are not for sale yet. Each of the automakers has a limited number of vehicles on the road in demonstration programs, including leasing with a limited number of vehicles to customers. For the most part, demonstration drivers for the available vehicles have already been identified.

#8

QUESTION:
How can I get one?

By 2017, the automakers expect that they will have placed almost 50,000 FCVs in customer hands—80 percent of those in Southern California. Vehicles and stations will be deployed together, making sure that customers have multiple places to fuel near the places they live, work and play. Most likely, the early commercial vehicles will be available in Santa Monica, Irvine, Torrance, Newport Beach, the San Francisco Bay Area and the Sacramento area. When vehicles become available, you'll find the information on the CaFCP website.

INTERESTING FACTS

- California leads the world in hydrogen fuel cell vehicle demonstration programs.
- More fuel cell passenger vehicles and buses are on California's roads than any other region of the world. California also has the most hydrogen fueling stations.

QUICK ANSWER

Be vocal about your support for fuel cell vehicles and hydrogen fuel.

LONG ANSWER

Although it will be several years until fuel cell vehicles are available for sale in California, and perhaps longer in other parts of the country, we have to start now. Being vocal in your support keeps attention on addressing these issues now.

#9

QUESTION:
What can I do to move this along?

Participate in organizations like the California Hydrogen Business Council, H2&You and Hydrogen Energy Center. Encourage your community to consider fuel cell transit buses. Be aware of local policies that may exclude one type of vehicle or fuel in favor of another and encourage people to keep an open mind. Ask the owner of your local gasoline station to add a hydrogen dispenser.

It's equally important that drivers change their habits to use less energy and reduce their carbon footprint. Reduce the number of miles you drive and make sure your vehicle is getting its best efficiency. Don't idle your vehicle. (Turning a car off and on uses less fuel than letting it idle.) Conserve, reduce, reuse and recycle.

INTERESTING FACTS

- The number of miles driven has doubled in the last decade.
- The average adult spends 75-83 minutes a day in a vehicle.
- 85% of personal travel is in a passenger vehicle, as opposed to public transit.

QUICK ANSWER

CaFCP works together to promote the commercialization of fuel cell vehicles.

LONG ANSWER

CaFCP members collaborate on the issues that move the vehicles to market. For example, California was the first state to designate hydrogen as a transportation fuel. With that designation came a need to immediately

#10

QUESTION:
What does CaFCP do?

set some standards and regulations. CaFCP members provided the Department of Measurement Standards with joint input about hydrogen quality regulations, instead of the agency receiving individual and conflicting input. DMS was able to create the regulation in months instead of years.

Some projects, like public outreach and fire fighter education, are ongoing. Other projects arise around one issue, like training drivers to use the stations. When the issue has been resolved, the project team disbands. The people, however, are all engaged on a day-to-day basis to move fuel cell vehicles closer to the market.

PUBLIC TOUR

On the fourth Friday of every month, the California Fuel Cell Partnership welcomes guests to tour the facility and hydrogen station, and ride in a fuel cell vehicle. Visit our website to learn more: www.cafcp.org.

QUICK ANSWER

It's the only way to reach our future goals.

LONG ANSWER

California has a goal of reducing greenhouse gas emissions to 80 percent below the 1990 level by 2050. Vehicles account for almost 40% of GHG emissions. To reach the reduction goal, we have to reduce the number of miles we drive and reduce GHGs created when producing and using fuel in our vehicles. Electric-drive vehicles, fuel cell and plug-in battery, are the optimum way to reach the goal.

#11

QUESTION:
Why make the investment now?

By 2050, most vehicles on the road must use electric drive, including FCVs, PHEVs and BEVs. It takes about 20 years to turn over the entire vehicle population, so by 2030 the automakers must have a wide variety of vehicles on the market: sports cars, sedans, vans, SUVs, pick-up trucks. They must be family vehicles, police cars, taxi cabs, rental cars and delivery trucks. By 2020, the automakers must be in full production of cost-effective, reliable vehicles. By 2010, the automakers must have a production design vehicle that meets consumer demands so they can start establishing the supplier chain for components, building the sales and service network and build customer acceptance.

FOUR TRUTHS ABOUT HYDROGEN

Fuel cell vehicles will be cost competitive with other options. Once in mass production, a FCV with 350-mile range will cost $3,600 more than a conventional car. A PHEV-30 will cost $4,300 more and a BEV-200 will cost $10,000 more.

Hydrogen is a clean, efficient fuel. FCVs using hydrogen made from natural gas are more energy efficient and cleaner than gasoline in a conventional vehicle, and on par with BEVs using electricity made from natural gas.

We can build the infrastructure in a smart and cost-effective manner. The National Research Council reports that $8 billion over 16 years can build stations to supply fuel for 1.8 million FCVs through 2020 and 10 million through 2025. (The existing global gasoline infrastructure costs $160 billion annually.)

Compressed hydrogen provides the range people want. In real-world driving, several FCVs have a range of 300-500 miles on a tank. Filling the tank takes just minutes.

For more information visit

www.cafcp.org