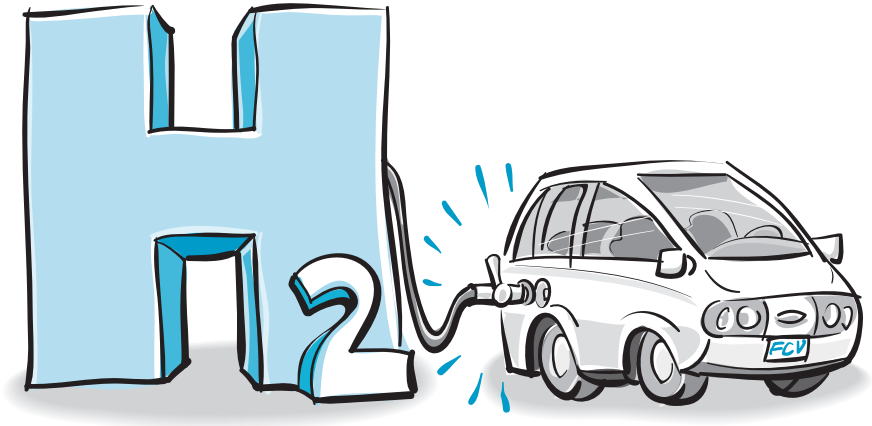


Frequently Asked Questions

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

INTRODUCTION

Fuel cell vehicles are real and ready for the commercial market. Hundreds are on the road now, and new hydrogen stations are preparing for thousands of passenger vehicles and dozens of buses coming to market beginning in 2015. FCVs combine the performance and emissions-free driving of an electric vehicle with the range and convenience of a traditional vehicle. FCVs powered by hydrogen help reduce pollution, greenhouse gases, energy use and dependence on oil.

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. Where are the stations?
6. What happens when the fuel cell wears out?
7. How does a fuel cell vehicle perform?
8. When can I get one?
9. Are the vehicles safe?
10. What does CaFCP do?
11. Are FCVs only in California?

#1

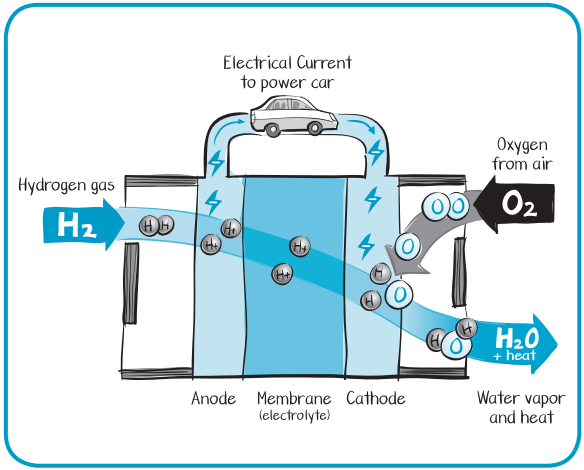
QUESTION:
How is a fuel cell different than a battery?

QUICK ANSWER

A battery stores electrical energy and a fuel cell converts hydrogen into electrical energy.

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.



When the hydrogen molecules come into contact with the catalyst, a chemical reaction converts the energy stored in the hydrogen into an electric current. A fuel cell will create a current as long as it has fuel. When the fuel supply is shut off, the reaction stops and therefore, so does the current.

A battery has an anode, a cathode and an electrolyte that allows a chemical reaction to occur. The reactants are inside the battery. When the battery operates, a chemical reaction releases electrons through an external circuit, providing a current. Some types of batteries can be recharged, which reverses the chemical reaction and allows energy to be stored again in the battery.

INTERESTING FACT

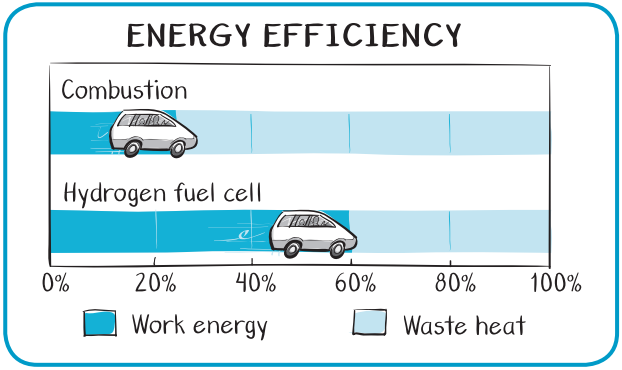
- PEM fuel cells in vehicles use hydrogen as fuel. Other types of fuel cells that power small devices (like phone chargers) or provide power to buildings can use other fuels, such as methanol, natural gas and biogas.

#2

QUESTION:
How efficient is a fuel cell?

QUICK ANSWER

Fuel cell vehicles are 2-3 times more efficient than today's 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 running on hydrogen is about 60% efficient. The vehicle's electric motor is also very efficient in converting the energy from the fuel cell into work.

A combustion engine is about 25% efficient when using gasoline. 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 FACTS

- The U.S. Department of Energy's target for fuel cell efficiency is 60%. DOE reports that efficiency is currently 59%.
- DOE's target for fuel cell cost is $40/kilowatt by 2020 with an ultimate target of $30/kW. In 2013, DOE reported cost at mass production levels is $55/kW.

#3

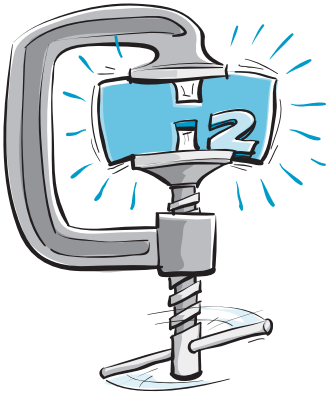
QUESTION:
Is the H_2 a liquid or gas?

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. So why don't FCVs use liquid hydrogen? To be a liquid, hydrogen must be stored at -423°F (-253°C). If the hydrogen

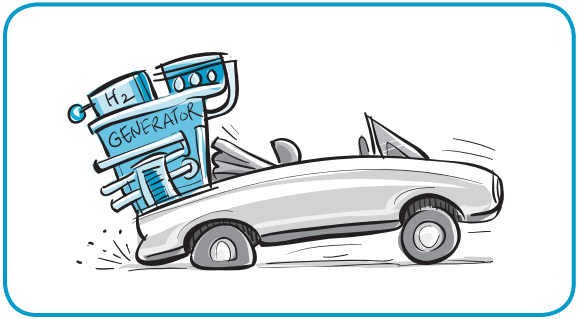
warms up even a little, it begins to evaporate. Tanks to hold hydrogen at a cryogenic temperature would have to be more insulated and heavier than tanks that hold gaseous hydrogen. At the station, fueling equipment would have to be well insulated, too, making it bulky and heavy.

INTERESTING FACTS

- Hydrogen dispensers list fuel pressure as H35 and H70. The numbers refer to pressure in megapascal (MPa) instead of psi or bar.
- Longer term, storing hydrogen in 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.

#4

QUESTION:
Why not make the H_2 onboard the vehicle?



QUICK ANSWER

It's possible, but not practical.

LONG ANSWER

Early on, 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 and dispense it at stations.

Filling a tank is a quick and simple process. A hydrogen dispenser nozzle looks similar to a nozzle on a natural gas or propane dispenser.

The driver locks the nozzle onto a valve on the vehicle. When the seal is tight, fuel flows into the tank. When the tank is full, the dispenser turns off. It typically takes less than five minutes to fill the tank at new stations.

INTERESTING FACTS

- The world produces hydrogen equivalent to more than 55 billion gallons of gasoline per year, enough to fuel 180 million fuel cell vehicles.
- About half 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.

#5

QUESTION:
Where are the stations?

QUICK ANSWER

Primarily in Los Angeles, Orange County and the San Francisco Bay Area.

LONG ANSWER

Early on, hydrogen stations were small, industrial-looking stations that were designed to fill automakers' test vehicles. As vehicles are coming into customer hands, the stations are hydrogen equipment added to existing gas stations.

CaFCP's members work closely together to identify areas where vehicles are coming to market first and where drivers need the first stations. The goal is to place clusters of stations in Los Angeles,

Orange County and San Francisco Bay Area; and connector and destination stations that will assure drivers that they have fueling locations across the state. Our roadmap calls for 68 stations to launch the market, quickly growing to 100 stations statewide. It's a two-pronged plan for customer convenience and station utilization.

Visit CaFCP's website to see pictures of some of California's hydrogen stations and our interactive map showing the locations of the stations already open and those in planning and construction.

INTERESTING FACTS

- California has about 11,000 gas stations, most owned by small businesses.
- In 2012, stations sold about 14.5 billion gallons of gasoline.
- In 2011, stations sold about 3.8 million gallons of E85.

#6

QUESTION:
What happens when the fuel cell wears out?

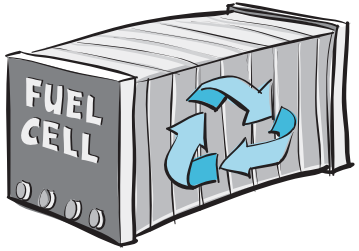
QUICK ANSWER

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

LONG ANSWER

Fuel cells are being designed to last the lifetime of the vehicle, about 150,000-200,000 miles.

Demonstration fuel cell vehicles have already accumulated more than 100,000 miles in real-world driving. 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.



Some people may choose to replace the fuel cell, however, just as some people choose to replace the engine in a conventional car.

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

- A fuel cell stack is about the size of a roll-aboard suitcase.
- Fuel cell durability is getting close to the Department of Energy goal of 5,000 operating hours (150,000 miles). The fuel cell in an AC Transit bus has more than 10,000 hours of durability in real-world operation.

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 and instant torque. Second, it's very quiet. Fuel cell vehicles have no combustion 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

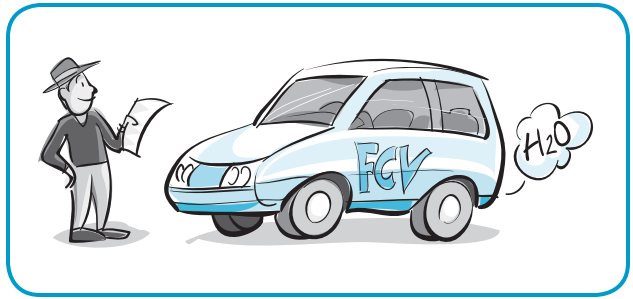
- Street traffic is the largest contributor to noise pollution. An average automobile operates at 65-75 decibels, diesel buses operate at 100 dB. Fuel cell passenger vehicles and transit buses operate at 50-60 decibels, about the same level as a refrigerator, a gentle breeze or an ordinary spoken voice.

#8

QUESTION:
When can I get one?

QUICK ANSWER

Transit buses are available now. Passenger vehicles are becoming available.



LONG ANSWER

Early commercialization of fuel cell electric vehicles has begun. Models are available today for consumers to lease and more have been announced for sale and lease between now and 2020. The California hydrogen station network is expanding to support the existing and growing lineup of FCVs.

Transit agencies are already buying fuel cell buses. The largest fuel cell bus program in the US is with AC Transit in the Berkeley/Oakland area. SunLine Transit in Palm Springs also operates fuel cell buses, including the first “All-American” buses. More transit agencies in California and nationwide will add fuel cell buses in the coming years.

INTERESTING FACTS

- 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.
- California drivers accounted for just under one-third of all battery electric vehicles purchased in the United States in 2012 and about a quarter of all hybrids.

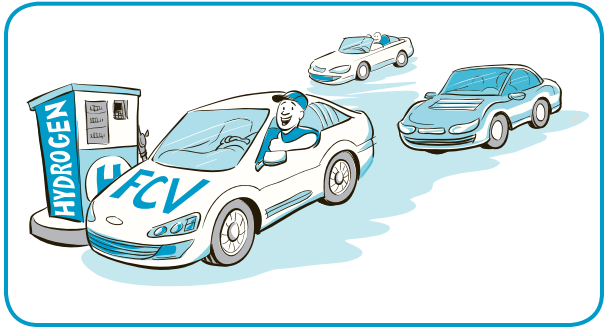
#9

QUESTION:
Are the vehicles safe?

QUICK ANSWER

Yes. They are as safe as the vehicles we drive today.

LONG ANSWER

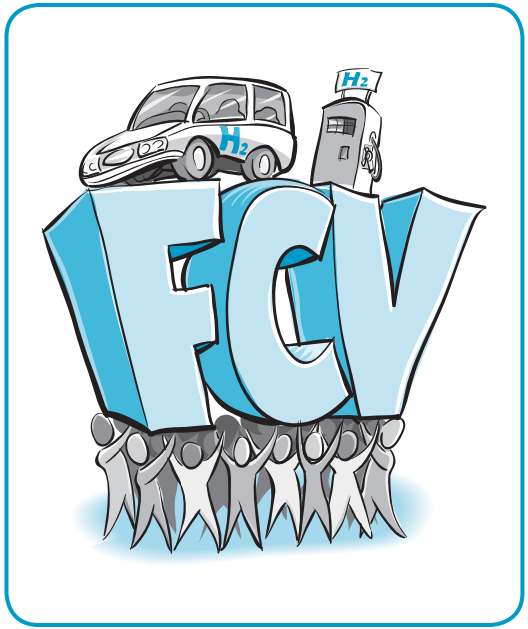


Automakers subject fuel cell vehicle models to extensive safety testing prior to releasing them on public roads, including destructive and non-destructive evaluations at the component, system and vehicle level. Hydrogen is as safe as other transportation fuels, but has different characteristics.

Sensors, valves and other safety features are specifically designed around hydrogen's lighter-than-air property. The on-board hydrogen storage tanks are extremely strong, carbon-fiber wrapped tanks. Similar to CNG tanks, hydrogen tanks are put through a series of stress tests, including bonfire, impact, burst and gunfire tests. The tanks must meet strict manufacturer guidelines and applicable DOT criteria to be on public roads.

INTERESTING FACTS

- The number of miles driven in the U.S. has doubled in the last decade.
- The average American 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 issues that move FCVs and hydrogen fuel to market. Many of our activities are centered around deployment planning so that stations and vehicles are rolled out in the same place and time.

#10

QUESTION:
What does CaFCP do?

We also tackle issues around selling hydrogen as a retail fuel instead of as an industrial gas. By giving input and making recommendations as a group instead of individual companies, we can shrink timelines from years to just months.

Some projects, like public outreach and firefighter education, are ongoing. Other projects arise around one issue, such as fueling standards or building codes. When the issue has been resolved, the project team disbands. People from CaFCP's member organizations are engaged on a day-to-day basis to move fuel cell vehicles closer to the market.

#11

QUESTION:
Are FCEVs only in California?

QUICK ANSWER

No—they are everywhere!

LONG ANSWER

California leads the world in deploying fuel cell vehicles and hydrogen stations, but other US states have programs as well.

H_2USA is a public-private partnership that is working to establish hydrogen fueling infrastructure across the U.S. H_2USA's working groups address locations, codes and standards, funding, and market acceleration activities that will promote nationwide adoption of FCVs.

Germany’s H2Mobility program is the largest in Europe. Other European programs are underway in the UK and Scandinavia. In Canada, a retailer’s distribution center is operating the largest fuel cell forklift fleet. Japan, Korea and China all have hydrogen programs for passenger vehicles, stations and transit buses, as well as for stationary fuel cells.

Nearly every industrialized country has a hydrogen and fuel cell program, some more focused on stationary and portable power than on transportation. All these programs, including CaFCP, coordinate and exchange information to bring fuel cell technology to the worldwide market as quickly as possible.

BENEFITS OF FUEL CELL ELECTRIC VEHICLES

Fuel cell vehicles powered by hydrogen are zero-emission, zero-petroleum vehicles.

- FCVs are zero-emission vehicles with range, refill time, power and performance similar to conventional vehicles.
- FCVs and hydrogen fuel will be cost competitive with other options.
- Hydrogen is a clean, efficient fuel that can be made from a variety of domestic resources. Every country and region of the world can produce hydrogen from a variety of sources using multiple methods.

Fuel cell vehicles are part of the advanced transportation family that includes batteries, biofuels and improved combustion engines. All vehicles are necessary to improve our environment and our world.

For more information visit

www.cafcp.org