

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 available today. More than 7,500 people in California are already driving an FCV, and transit agencies are operating fuel cell transit buses. Retail hydrogen stations are open, and the network is growing statewide.

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. Are FCVs good for the environment?
3. Where are the stations?
4. How is hydrogen produced?
5. Why not make the H₂ onboard the vehicle?
6. What maintenance does a fuel cell car need?
7. How does a fuel cell vehicle perform?
8. Are FCVs and hydrogen safe?
9. Are fuel cells only in cars?
10. Are FCVs only in California?
11. Will all cars use fuel cells one day?

QUICK ANSWER

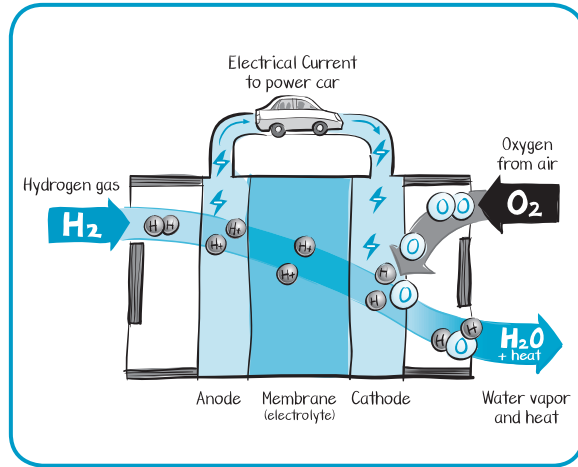
A battery stores electrical energy and a fuel cell converts hydrogen into electrical energy.

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.



#1

QUESTION:

How is a fuel cell different than a battery?

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.

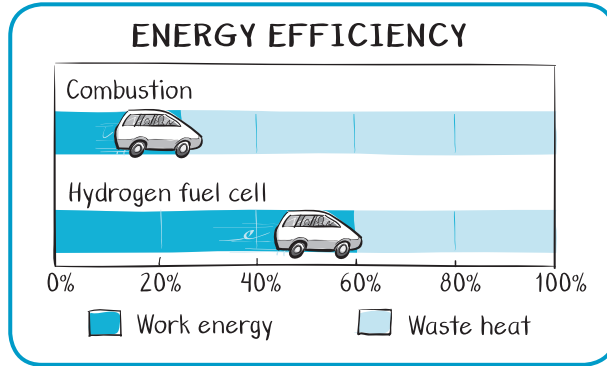
QUICK ANSWER

FCVs are energy efficient and have zero tailpipe emissions.

LONG ANSWER

Environmental impact of vehicles is measured in two ways: 1) well

to wheels, which covers the production of fuel to the vehicle's emissions and 2) cradle to grave, which covers vehicle production, 15 years of operation, and destruction. Both models show that FCVs powered by hydrogen significantly reduce greenhouse gas emissions, air pollutants, and are two-to-three times more energy efficient than a combustion vehicle.



#2

QUESTION:

Are FCVs good for the environment?

Making hydrogen is a chemical process—no matter the source of the hydrogen—and results in nearly zero air pollutants from well to wheels. Because California has so many renewable sources of electricity and hydrogen, FCVs and battery-electric vehicles are very similar in greenhouse gas reduction.

From cradle to grave, FCVs paint a very good picture. Argonne National Lab modeled the cost of avoided GHG emissions and found that at the state of current technology, FCVs and BEVs are about equal at \$1,200 per tonne of CO₂ avoided. Future technology shows FCVs at about \$200/tonne and BEVs at about \$500 per tonne.

MORE INFORMATION

- Argonne National Labs modeling is available at greet.es.anl.gov. CaFCP has summaries of the GREET reports using only California mixes of all fuels at www.cafcpc.org.

QUICK ANSWER

Throughout California, and coming to the East Coast.

LONG ANSWER

Most hydrogen stations are in the big metropolitan areas: Los Angeles, Orange County, and the San Francisco Bay area. Stations are built in clusters based on the daily driving patterns of most commuters.

Destination stations are in cities that include Santa Barbara, Lake Tahoe/Truckee, the Napa Valley, and San Diego. Connector stations in Sacramento and Harris Ranch help ensure people can use their FCVs just as they do a conventional vehicle.



#3

QUESTION:

Where are the stations?

At the current pace of construction, California will have about 60 retail hydrogen stations open by the end of 2021, and more under construction. The goal is to have at least 200 hydrogen stations statewide by 2025 and 1,000 stations by 2030.

Hydrogen stations for buses and trucks are also open and in construction throughout the state, and the first stations in the Northeast U.S. are in development.

MORE INFORMATION

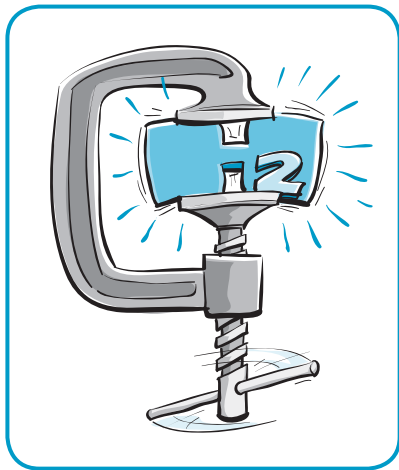
- CaFCP's interactive station map at www.cahcp.org/stationmap displays open and in development hydrogen stations.
- Visit H2USA.org for hydrogen station plans outside of California.

QUICK ANSWER

Mostly from natural gas, but also from renewables.

LONG ANSWER

Hydrogen has been produced from natural gas for more than 75 years in an efficient chemical process that produces zero air pollutants. Most hydrogen is used in gasoline refining; other uses include food processing, manufacturing, fertilizer production, and in pharmaceuticals.



#4

QUESTION:

How is hydrogen produced?

In California, at least 1/3 of hydrogen for transportation must come from renewables, which includes solar or wind powered electrolysis of water, biogas (such as wastewater), or biomass (agricultural waste.)

An advantage of hydrogen as a fuel is that every region can make hydrogen from its own resources, which greatly improves energy security and resiliency.

INTERESTING FACTS

- Natural gas (CH_4) and water (H_2O) react under heat and a catalyst to produce three H_2 molecules and one CO molecule.
- Electrolysis uses electricity and a catalyst to break water molecules (H_2O) into H_2 and O_2 .
- Hydrogen and oxygen are diatomic molecules—H and O do not exist by themselves in nature.

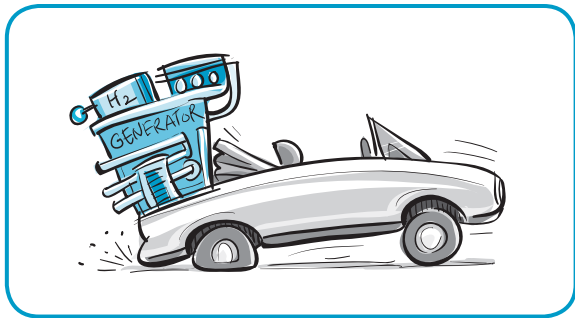
QUICK ANSWER

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.



#5

QUESTION:

Why not make the H₂ onboard the vehicle?

The driver locks the nozzle onto a valve on the vehicle. When the seal is tight, compressed gaseous hydrogen flows into the tank. When the tank is full, which takes less than five minutes, the dispenser turns off.

INTERESTING FACTS

- Hydrogen is sold by weight instead of by volume and uses the same unit of measurement—kilogram—everywhere in the world.
- Hydrogen is the only fuel in the U.S. that is sold in whole pennies instead of 9/10ths of a cent.
- Currently, all automakers provide about three years worth of free hydrogen with the purchase or lease of a car.
- By 2025, the price of hydrogen is expected to cost less per mile than gasoline.

QUICK ANSWER

Brakes, air filters, top off the coolant.

LONG ANSWER

Fuel cell vehicles are electric cars and, therefore, don't have many moving pieces. You will not have to change the oil, have a smog test, replace the belts or spark plugs.

You will have to replace air filters and top off a few fluids, but the automakers provide no-cost scheduled maintenance for three years.

The automakers also provide warranties for all key fuel cell components, including the fuel cell stack, compressor, hydrogen



#6

QUESTION:

What maintenance does a fuel cell car need?

tanks, battery packs, and fueling control units. The fuel cell stacks are designed to last the lifetime of the vehicle, about 150,000–200,000 miles. 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.
- More than 14,000 fuel cell forklifts are in use by businesses across North America.
- Four transit agencies in California operate 31 fuel cell buses in every-day service and more than 25 additional buses and four shuttles are coming.



QUICK ANSWER

Great!

LONG ANSWER

In most respects, a fuel cell vehicle drives like a conventional gasoline vehicle. It has power and performance—great pick-up and easily cruises at freeway speeds. FCVs have maximum torque at zero miles per hour, which means powerful acceleration from 0 to 60—and from 30 to 60.

On the inside, FCVs have plenty of space for passengers and cargo.

#7

QUESTION:

How does a fuel cell vehicle perform?

The cars have high-end finishes and advanced technology. The dashboard gauges display driving range, power management and provide feedback about driving style. Many use recycled or recyclable materials in the cabin.

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. Second, the car or bus is very quiet. You don't realize how loud an engine is until that sound is absent!

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.

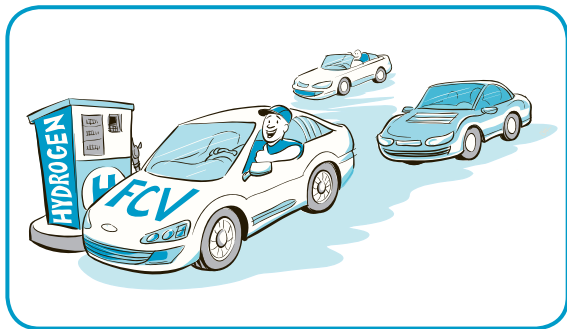
QUICK ANSWER

Yes, as safe as the vehicles and fuel we use 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. For example, it's lighter than air, odorless, and non-toxic.



#8

QUESTION:

Are FCVs and hydrogen safe?

Safety systems at the station and on the vehicle are designed for a buoyant, gaseous fuel and are designed to work together. On the small chance that hydrogen does escape from the vehicle or station, it quickly disperses in the atmosphere.

INTERESTING FACTS

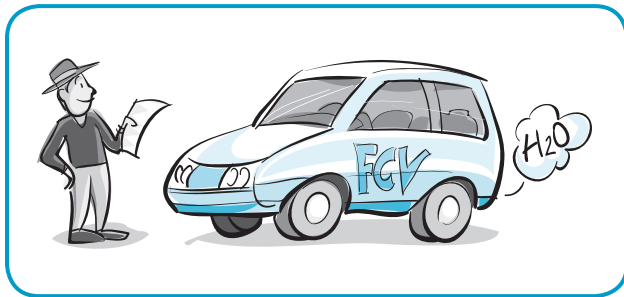
- Hydrogen stations are closed-loop systems. Nothing drips or spills when you fill the tank.
- National codes and standards for hydrogen as a fuel already exist.
- Hydrogen has been safely delivered by truck, rail, ship, and pipeline for nearly a century.

QUICK ANSWER

Fuel cells power all sorts of things!

LONG ANSWER

Transit agencies in California and other parts of the U.S. are already buying fuel cell buses. SunLine Transit and AC Transit, are working toward fleets of 40 or more fuel cell buses. Hundreds of companies in North America are operating fuel cell forklifts and lift trucks. Fuel cells for material handling applications make business sense, particularly in 24-hour operations.



#9

QUESTION:

Are fuel cells only in cars?

Fuel cells also provide stationary and back-up power to buildings. Grocery stores use fuel cells for “peak shaving” and to provide power to their freezers if the electricity goes out in a snow storm. Large data centers like fuel cells because they provide consistent power that isn’t subject to brown outs. Fuel cells provide emergency power to cell phone towers and railroad crossings making sure they function in an emergency. Heavy-duty vehicle fuel cells are just getting underway—locomotives, ships, ferries, drayage trucks, delivery vans. And consumer electronics companies are experimenting with tiny fuel cells to replace batteries in portable devices, such as computers and tablets.

INTERESTING FACTS

- Nearly all space travel in every country is powered by fuel cells and hydrogen.
- Invented in the mid-1800s as a “gas battery,” fuel cells got their current name in 1889.
- Interest in automotive fuel cells took hold during the 1973 oil crisis.

QUICK ANSWER

No—they are everywhere!

LONG ANSWER

California leads the world in deploying fuel cell vehicles and hydrogen stations, but other U.S. states are launching their own efforts, and 12 stations in Northeast states will pave the way.

H2USA is working to establish hydrogen stations across the U.S. by addressing locations, codes and standards, funding, and market acceleration activities that will promote nationwide adoption of FCVs.



#10

QUESTION:

Are FCVs only in California?

Germany's H2Mobility program is the largest in Europe. Other European programs are underway in the UK, throughout the European Union, and in Scandinavia. Japan is focusing on hydrogen and fuel cells for the 2020 Olympic Games, China has the world's largest fuel cell bus manufacturing program underway, and Korea is launching a pilot program of fuel cell taxis and car-sharing services.

Nearly every industrialized country has a hydrogen and fuel cell program. Some are more focused on stationary and portable power than on transportation, and others are exploring ways to use hydrogen for storing excess wind energy. All these programs, including CaFCP, coordinate and exchange information to bring fuel cell technology to the worldwide market as quickly as possible.

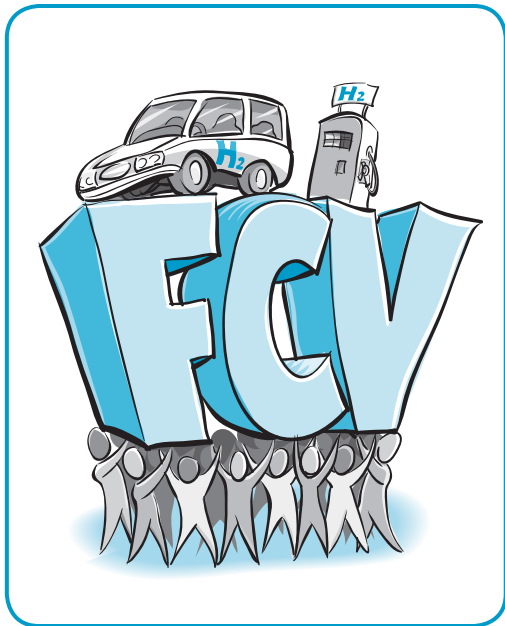
QUICK ANSWER

Unlikely. Our future needs a variety of fuels.

LONG ANSWER

More than 255 million vehicles are registered in the United States, and nearly all of them run on gasoline or diesel.

When most (or all) of the vehicles rely on the same fuel, our energy system is vulnerable to disruptions in supply or the ability to transport the supply.



#11

QUESTION:

Will all cars use fuel cells
one day?

California's Alternative Fuels Plan estimates that we can displace four billion gallons of gasoline by 2020 through a diversity of alternative fuels. States with zero-emission vehicle regulations are looking to meet goals of millions of ZEVs by deploying fuel cell and battery electric vehicles.

Automakers and government regulators see fuel cells and batteries as two sides of the same coin. The vehicles share many electrical components and are often designed by the same engineering groups. All major automakers see both types of ZEVs in the future.

While you may read about winners and losers in blogs and articles, the real match is between alternative and conventional fuels. It takes all of us working together to end petroleum's grip on transportation.

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