



Getting gas:

Drivers fill their fuel cell electric vehicles with gaseous compressed hydrogen at a station in Torrance, Calif. This is one of nine public stations already open. With others under construction and in planning, California is on track to have about 100 stations statewide to support the commercial introduction of FCEVs.

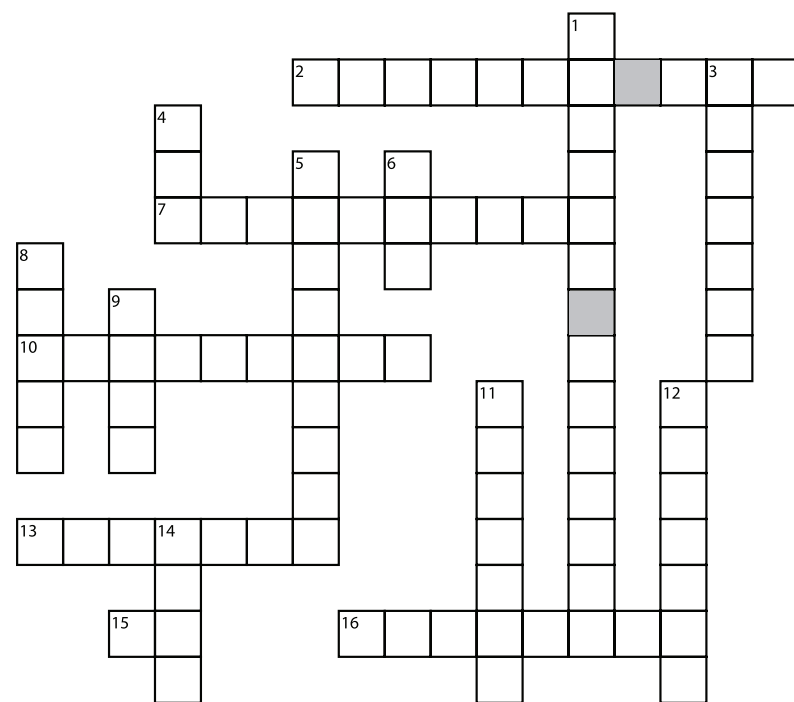


Renewable hydrogen:

The hydrogen station in Fountain Valley makes hydrogen from wastewater at the Orange County Sanitation District. The production equipment (pictured) creates 100/kg of hydrogen, 12% of the plant's electricity and hot water for treating sewage every day. This project is a collaboration between the Department of Energy, State of California, and South Coast AQMD, a local air quality agency.

Crossword

Superheroes and Villains



ACROSS

- 2 Fuel represented by a blue flame (2 words)
- 7 State with an alt fuel incentive program
- 10 Creates electricity using hydrogen
- 13 Fuel made mainly from corn
- 15 Small particles in the air
- 16 Fuel made from a chemical process

DOWN

- 1 Result of higher GHGs (2 words)
- 3 Lung disease associated with pollution
- 4 State agency that funds alt fuels
- 5 Fuel made mainly from soybeans
- 6 Creates acid rain
- 8 Organization that made this paper
- 9 Amount of emissions from an FCEV tailpipe
- 11 Rechargeable energy supply
- 12 Behavior change that reduces pollution
- 14 Local air quality agency

HEROES VS. VILLAINS

ALTERNATIVE FUELS COMBAT POLLUTION

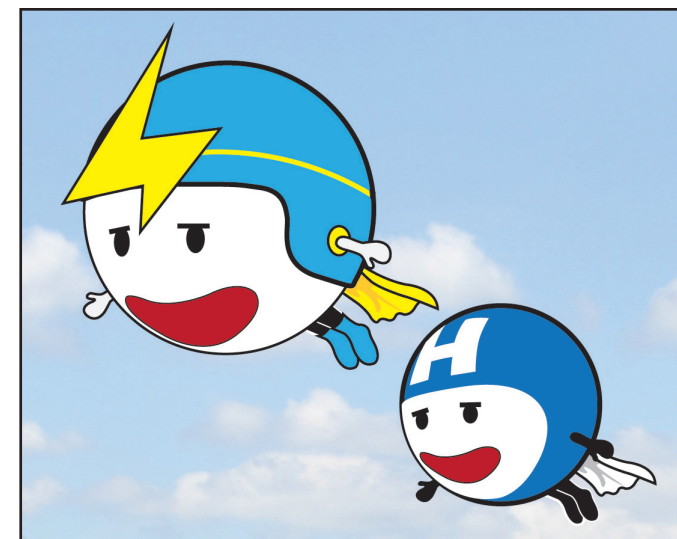
Although California has significantly reduced air pollution levels, more than 90% of Californians breathe unhealthy levels of air pollutants—PM, NOx and VOCs—during some part of the year. Studies show that pollution concentrations along Los Angeles freeways are five to 10 times higher than elsewhere in the city and that asthma is more prevalent among children living near higher traffic roads and freeways.

If pollution levels in the South Coast Air Basin and San Joaquin Valley improved to federal standards, residents would suffer 3,860 fewer premature deaths, 3,780 fewer nonfatal heart attacks and miss 470,000 fewer days of work annually. School children would miss 1.2 million fewer days of school, a savings of \$112 million in caregiver costs.

“Dirty air is like a \$28 billion lead balloon on our economy,” said Cal State Fullerton professor, Dr. Jane Hall.

Greenhouse gases are also air pollutants. CO₂ released from transportation and energy production are causing global warming. Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather, which will impact California.

Although these air pollution villains come from many sources, transportation is a leading cause of pollution and greenhouse gas emissions. It's time for alternative fuel superheroes to knock out pollution.



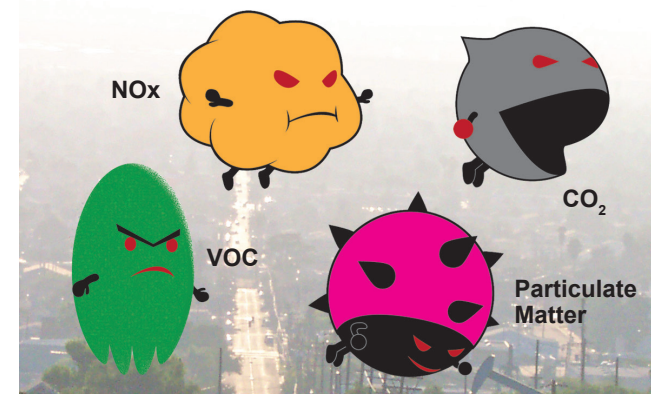
Fuel Cell and Hydrogen: Champions for clean air and climate change

Fuel Cell and Hydrogen: Zero Emissions

The superhero, Fuel Cell, creates electricity to power vehicles of all sizes—from small scooters to transit buses—with performance, range and refill time similar to combustion vehicles. Vehicles powered by Fuel Cell are quiet, powerful and have zero emissions.

Hydrogen, our other superhero, carries energy to Fuel Cell. Made from local, domestic sources and even renewable sources, Hydrogen brings diversity to this dynamic duo. Because it's born in a chemical process, not combustion, it doesn't create PM, NOx, VOCs or other pollutants.

These superheroes are already on the road under the hoods of major automakers' FCEVs and transit agencies' fuel cell buses in California and around the world. Fuel cell electric vehicles will provide customers with a no-compromise electric-drive vehicle with longer range, quick refill, high performance and comfort along with zero tailpipe emissions and reduced (or zero) greenhouse gas emissions.



Bumper to Bumper

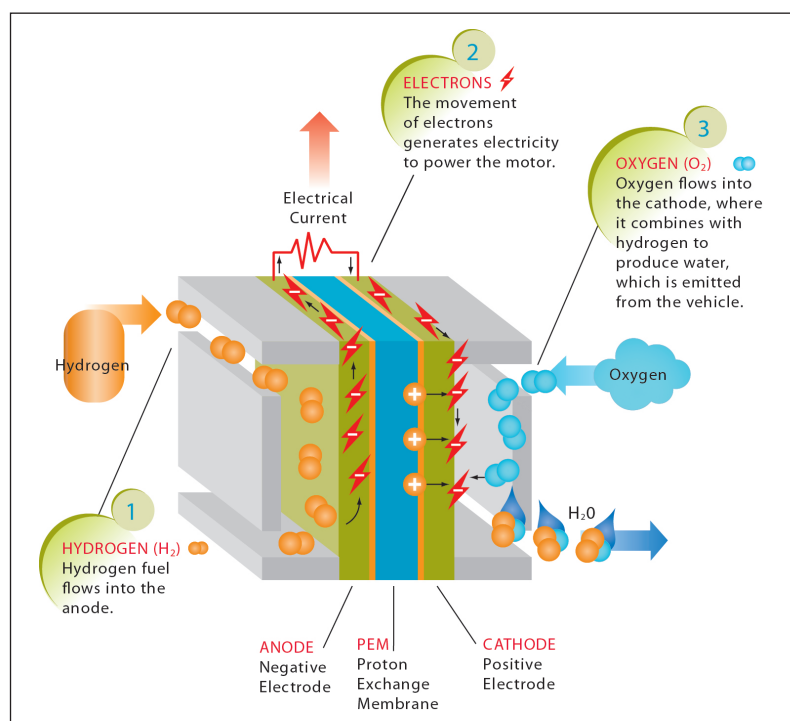
Zero emission vehicles stop tailpipe pollution

When you drive in bumper-to-bumper traffic, pollutants outside can seep into your car, making the air you breathe inside your car up to 10 times more polluted than typical city air, according to the Coalition for Clean Air. Moving to cleaner burning fuels and more efficient engines like zero-emission electric vehicles can reduce pollutants from the tailpipe and eliminate the villains.

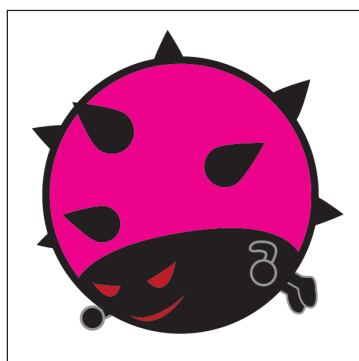
A fuel cell creates electricity from hydrogen and oxygen. Because it's not burning fuel, a fuel cell creates zero tailpipe pollution and zero greenhouse gases. The only exhaust is a little water vapor; no more than a car puts out today.

On California's Smog Scorecard for new vehicles, FCEVs rate a 10—the cleanest.

How a fuel cell works: Fuel cells force hydrogen to separate into proton and electron in an electrochemical reaction. The electron carries energy to the electric motor and on board systems.

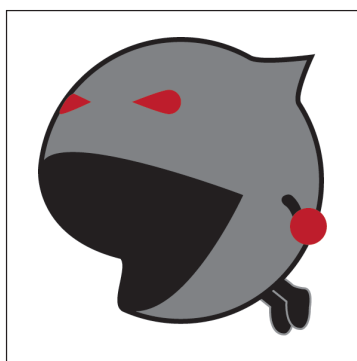


Air Pollution and GHG Villains



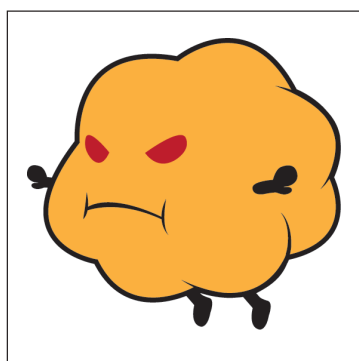
Particulate Matter

Known by two sizes, 2.5 and 10, PM is very small liquid and solid particles suspended in air. Causes lung disease and heart failure, and can turn the air hazy and brown. Especially dangerous when emitted at ground level, such as vehicle exhaust pipe.



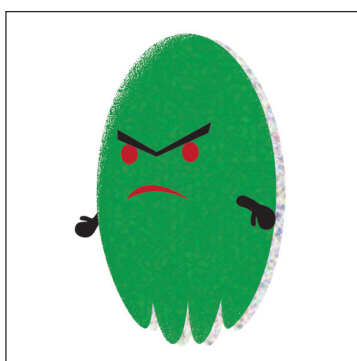
CO₂

While not a direct impairment to human health, CO₂'s mission is to trap heat and warm the earth's atmosphere. Humans make most of this villain by burning fossil fuels in vehicles and to make electricity. It can last 200 years in the atmosphere.



Oxides of Nitrogen

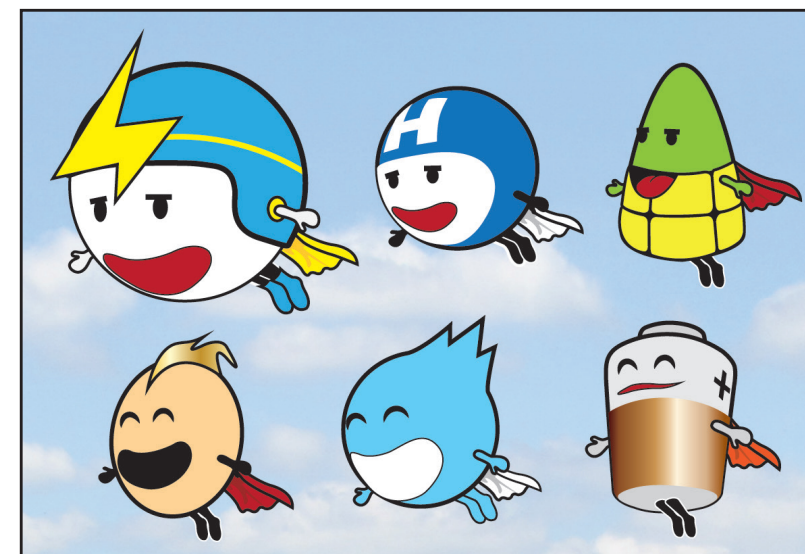
Known as "NOx," this villain turns the air brown and creates acid rain. With others in the pollution gang, creates smog and ozone. NOx irritates your eyes and nose, and makes plants lose leaves. Can even crack rubber and corrode metal. Found in vehicle exhaust.



VOC

Volatile Organic Compound (aka Hydrocarbons) escape from vehicle exhaust pipes, evaporating fuels and other chemicals. VOCs and NOx form the Ozone gang. Ozone burns your eyes, irritates noses and throats, and can impair breathing.

*Not pictured: SOx and CO



The Clean Air League: (clockwise from top left) Fuel Cell, Hydrogen, Ethanol, Battery, Natural Gas, Biodiesel — superheroes work together to knock out pollution and global warming

ZEV Action Plan

In March 2012, Governor Brown issued an executive order directing state government to help accelerate the market for zero-emission vehicles: hydrogen fuel cell electric vehicles and plug-in electric vehicles. Advancing the full range of electric-drive technologies rather than concentrating on one particular technology provides the state with the greatest opportunity to meet its zero-emission vehicle goals.

Accelerating the market for ZEVs is a cornerstone of California's long-term transportation strategy to reduce pollution and greenhouse gas emissions, reduce energy, and enable continued economic growth. The Governor's executive order and this action plan concentrate on advancing ZEVs, recognizing the timely opportunity to accelerate use of this commercially available technology.

In addition to promoting these vehicle technologies, the state supports the development and use of low carbon fuels, as well as planning more environmentally sustainable communities that reduce unnecessary vehicle travel and congestion.

Reaching our environmental and energy goals requires an "all of the above" strategy.

Helping build a sustainable future for all Californians.

For more information about hydrogen fuel cell electric vehicles and the work of the California Fuel Cell Partnership, please visit us at www.cafcp.org

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Progress in FCEVs

General Motors and **Honda**, with 1,200 patents between them, are teaming up to tackle cost challenges and try to speed the adoption of fuel cell vehicles by 2020.

Honda plans to launch the successor of FCX Clarity in Japan and the United States in 2015, and then in Europe. GM will announce its fuel cell production plans at a later date.

Toyota confirmed today that it will roll out its first commercially available hydrogen fuel cell vehicle next January at the 2014 Consumer Electronics Show in Las Vegas. At the Frankfurt Motor Show next month, we expect to hear more about the automaker's latest improvements to fuel cell technology.

Hyundai intends to put its fuel-cell Tucson into "small-scale mass-production." The aim is to ramp output up to 10,000 units a year after 2015 mostly for California and Europe.

The **Department of Transportation** awarded \$13.6 million in grants to advance the commercialization of American-made fuel cell buses for the transit industry. Recipients include **SunLine Transit**, **AC Transit** and **Ballard Power Systems**.

Ballard, FuelCell Energy and PlugPower stocks have surged in recent weeks as investors bet fuel cells.

Toyota and **Honda** are aiming at making FCEVs available for less than \$50,000, according to a Nikkei report.

Fellowship Available



U.S. Dept. of Energy seeking candidates for fuel cell fellowship. Scientists, engineers, and researchers work in the DC office and participate in projects that support hydrogen and fuel cell activities with mentoring from senior staff.

Apply at energy.gov/eere/education/energy-efficiency-and-renewable-energy-science-and-technology-policy-fellowships.