

Hydrogen fuel is getting buzz, but here's why it hasn't gone mainstream

October 2 2019, by Sarah Nightingale

How to Get Hydrogen

Electricity can be used to collect hydrogen from water. Scientists are looking for smarter ways to make this happen.

Electrolysis

An electrical current passed through water can split water into its components—hydrogen and oxygen. Researchers worldwide are studying catalysts to make the process more efficient and cheaper.

The diagram shows a cross-section of water with a lightning bolt labeled 'Current' striking it. Above the water, there are two circles: a minus sign (-) on the left and a plus sign (+) on the right. Below the water surface, blue dots representing hydrogen are on the left, and pink dots representing oxygen are on the right. Arrows point from the water towards these dots. The word 'Water' is written in the middle of the water surface.

Photoelectrolysis

Some scientists are studying how to use sunlight to fuel reactions that can split water into hydrogen and oxygen. And other methods don't use electricity as an intermediary at all.

The diagram shows a yellow sun labeled 'Light source' with an arrow pointing to a blue grid labeled 'Solar panel'. Below the solar panel, there are two circles: a minus sign (-) on the left and a plus sign (+) on the right. A lightning bolt labeled 'Current' strikes the water below. Below the water surface, blue dots representing hydrogen are on the left, and pink dots representing oxygen are on the right. Arrows point from the water towards these dots. The word 'Water' is written in the middle of the water surface.

Biological Methods

Algae naturally produces hydrogen. It could be used to split water into hydrogen and oxygen for human use. Don't plan on it anytime soon, though: The research is preliminary.

The diagram shows a yellow sun labeled 'Light source' with three arrows pointing down to a green wavy shape labeled 'Green microalgae photosynthesis'. Below this shape, there are two circles: a minus sign (-) on the left and a plus sign (+) on the right. Arrows point from the water towards blue dots representing hydrogen and pink dots representing oxygen. The word 'Water' is written in the middle of the water surface.

Credit: 5W Infographics

The hydrogen fuel that launches NASA rockets into space and provides electrical power via fuel cells produces only one waste product: water so pure the astronaut crew can drink it.

Here on Earth, the first cars powered by [hydrogen fuel](#) cells hit the market in 2015, promising cleaner air and a healthier planet. But if you have yet to see one on the road, you're not alone. There are fewer than 7,000 in the U.S. So why hasn't hydrogen gone mainstream as an alternative to gasoline-powered engines?

Paul Ronney, a USC Viterbi School of Engineering professor of aerospace and mechanical engineering who studies combustion and propulsion, says hydrogen has some barriers before it, including efficiency and cost. He is studying what it would take to overcome some of them. Here, he brings us up to speed on the role of hydrogen in the field of alternative fuels.

What benefits do hydrogen fuel cell-powered cars offer?

They don't emit greenhouse gases from the tailpipe, so they can reduce pollution in [urban areas](#) with poor air circulation, like Southern California in the U.S. and many large cities in India and China.

Hydrogen-fueled cars sound squeaky clean. Why aren't we all driving them?

There's virtually no pure hydrogen on Earth because it's so reactive. Most hydrogen is made from methane [natural gas] in a process that produces carbon dioxide and other greenhouse gases. Hydrogen can also be made from water using electrolysis, but that requires electrical energy. To get that, we're back to burning [fossil fuels](#).

Can hydrogen be made without creating greenhouse gases?

Solar-based electricity can be used to split water into hydrogen and oxygen using electrolysis. Since solar provides only a fraction of the total electricity generated in the U.S., diverting solar-based electricity to make hydrogen doesn't reduce greenhouse gas emissions. That could change if solar-based electricity is ramped up in the future.

Hydrogen is only as clean as the energy used to produce it. Are there other limitations?

Hydrogen in vehicles must be compressed in expensive high-pressure tanks, which requires—you guessed it—energy. Current hydrogen vehicles use fuel cells to convert the chemical energy to power. Fuel cells are very costly because they are complex and require expensive materials such as platinum.

Can we get around that?

Fuel cells are appealing because, in theory, they overcome efficiency limitations associated with traditional internal combustion engines. Think of the energy wasted as heat and noise in a traditional vehicle. While many scientists are exploring ways to make cheaper fuel cells, my research takes a different approach: improving the feasibility of internal

combustion engines that use hydrogen.

What are the advantages of burning hydrogen?

First and foremost, internal combustion engines are cheap to make and can easily be modified to run on hydrogen. As with fuel cells, the main [waste product](#) is water, not carbon dioxide. Also, unlike gasoline, hydrogen burns well in "fuel-lean conditions," where there's a lot more oxygen than fuel. That's good for fuel efficiency and also vastly reduces nitrogen oxide emissions.

How about using hydrogen in stationary applications?

The transportation sector has been asked to bear the brunt of the responsibility for reducing [greenhouse gases](#) even though it contributes only one-third. If we're serious about tackling [climate change](#) we need to move away from fossil fuels in non-vehicle applications also. The idea of piping hydrogen into homes or businesses seems far-fetched, but it is possible. The current liquid [natural gas](#) infrastructure could be modified for hydrogen. The flammability of hydrogen presents safety concerns, but with the right provisions these concerns can be mitigated—electricity is dangerous, yet we're all using that.

Provided by University of Southern California

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