

HYDROGEN FORWARD

What is Hydrogen?

The most abundant element in the universe, hydrogen is all around us – in the atmosphere, in space, and even in our own bodies. But on Earth, it naturally exists only bonded to other elements: for example, in water, fossil fuels, plant matter, and biogas. With the help of technology and a chemical reaction, hydrogen can be separated from other elements and harnessed as an energy carrier to transport and store energy for future use.

Hydrogen is commonly turned into electricity through two processes: COMBUSTION OR ELECTROLYSIS

Because hydrogen exists everywhere, it can also be generated anywhere there is combustion or electrolysis capability.

Steam methane reforming

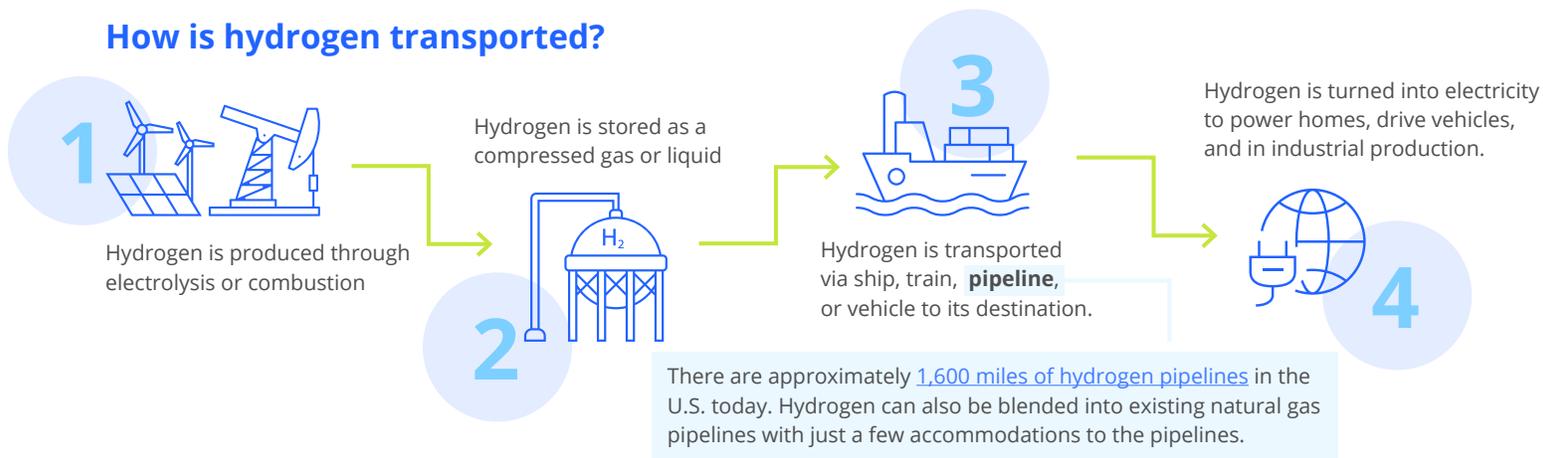
Feedstocks such as [natural gas and biogas](#) can be combusted into hydrogen through a process known as steam methane reforming. When heat and a catalyst force the feedstock and water to react, the reaction produces hydrogen, and carbon. Combined with carbon capture and storage, this pathway decreases greenhouse gas emissions and decarbonizes the energy process.

Electrolysis

An electric current separates water into hydrogen and oxygen. The electricity required for electrolysis can be produced by renewable resources, such as wind and solar. Hydrogen then “stores” the energy for future use. Through electrolysis, hydrogen acts as a storage mechanism for renewable energy with intermittent production, which can then be used when needed.

After hydrogen is produced through combustion or electrolysis, it is stored onsite for future use, or transported to a destination.

How is hydrogen transported?

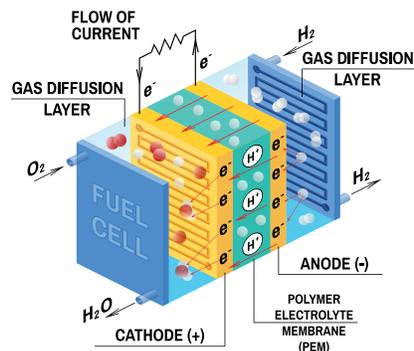


Once hydrogen is ready to be turned into energy, a fuel cell converts stored hydrogen into electricity.

What's a fuel cell?

In a fuel cell, hydrogen and oxygen combine to generate heat, water and electricity through an electrochemical reaction.

The only byproduct of generating power through a fuel cell is water vapor. Fuel cells are clean, reliable, and efficient. And they are quiet: fuel cell passenger vehicles and municipal buses operate on the same [decibel level](#) as a refrigerator, decreasing noise pollution.



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What can hydrogen be used for?

End uses of hydrogen include:

TRANSPORTATION

Driving vehicles including cars, trucks, buses, boats, warehouse fleet vehicles like forklifts, and in the future, trains and even airplanes.

POWER

Hydrogen fuel cells are frequently installed as reliable back up power for banks, data centers, hospitals, and other important facilities that must maintain uninterrupted service/ activities even through power outages and inclement weather.

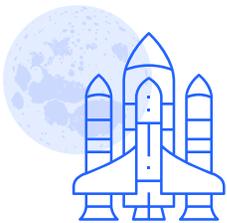
INDUSTRIAL PROCESSES

Hydrogen has been used for decades in gasoline refining, food processing, manufacturing, fertilizer production, and pharmaceuticals. It is currently the only zero-emission technology capable of producing the extreme heat necessary for the production of energy-intensive industrial materials like cement, steel, and glass.

- These zero-emission vehicles can refuel in **less than 10 minutes** for heavy duty trucks and **less than 5 minutes** for passenger vehicles. Most can travel **300-400 miles** on a full tank.
- There are **thousands of hydrogen fuel cell vehicles already on the road** in California, Europe, Japan, South Korea, and China.
- There are over **30,000** forklifts and other material handling equipment **powered by fuel cells** operating in U.S. warehouses today, with some of the biggest users being Walmart, Amazon and BMW.

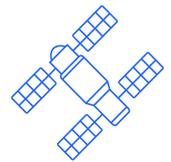


- How does this work in practice? Fuel cell power systems can provide reliable back-up power and zero-emission electricity to medical facilities, ensuring that patients can breathe cleaner air and don't have to worry about power black outs during storms.
- Many of these fuel cells providing back up power are **replacing diesel generators**, allowing companies to find innovative ways to **reduce their emissions profiles**.



FUN FACT

Almost all space travel is powered by fuel cells and hydrogen. For decades, [NASA crew and cargo missions](#) have used hydrogen as rocket fuel and as life support for space stations.



The Bottom Line

An odorless, non-toxic element, hydrogen can be produced from easily accessible resources all over the country, transported to its destination and converted into zero-emission energy when and where needed.

About Hydrogen Forward

Hydrogen Forward is a joint initiative of companies committed to advancing hydrogen for a cleaner, stronger U.S. economy. The coalition works in concert with allies across industries and sectors to educate decisionmakers and other stakeholders on the value hydrogen delivers today and the important role that it should play in our future. To learn more about the initiative and its member companies, visit www.HydrogenFwd.org.