

## ABOUT RENEWABLE HYDROGEN

### Hydrogen Use in the United States

Hydrogen is the lightest and most abundant element on earth, but doesn't exist in nature in its pure form and has to be separated from another substance like a fossil fuel or water. It is colorless, odorless, non-polluting and non-toxic, but is flammable. The US currently produces about ten million metric tons of hydrogen per year; 90% of that hydrogen comes from fossil fuels and has a significant carbon footprint.<sup>1</sup> Hydrogen has many common uses including as rocket fuel, to refine petroleum projects, to make fertilizer and in metals and food processing.

### What is Renewable Hydrogen?

Instead of extracting hydrogen from fossil fuels, renewable hydrogen is made by using renewable energy (wind, solar, hydropower, etc.) to separate water into hydrogen and oxygen using a process called electrolysis that captures the hydrogen and releases the oxygen into the atmosphere.

### More Ways to Decarbonize Our Economy

The promise of low or zero carbon hydrogen creates lots of opportunities to reduce carbon and other greenhouse gas (GHG) emissions from industrial processes where hydrogen is presently a key component, and in areas where hydrogen has not traditionally been used.

**Transportation:** Renewable hydrogen provides a low or zero-carbon, emission-free alternative to gasoline, diesel and other fuels for all modes of transportation. In passenger cars, and medium and heavy duty trucks, for example, fuel cells convert the hydrogen fuel into electricity fed into a battery with the only tailpipe emission being pure water that's clean enough to drink. The power is created by an electrochemical reaction instead of combustion like in a gas or diesel vehicle.

Other benefits include fast fuel times, less weight and longer range than battery electric vehicles. Renewable hydrogen and clean derivatives are also in advanced stages of research as zero emission replacement fuels for cargo ships and airplanes.

**Energy Storage:** Renewable hydrogen-based clean fuels can store energy in larger quantities and for longer duration than batteries at an economical price point. This type of affordable storage is needed to achieve 100% carbon-free power grids even when the wind isn't blowing and the sun isn't shining. Hydrogen can be stored in tanks, pipelines, or made into clean fuels such as ammonia and methanol.

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<sup>1</sup> Extracting hydrogen from coal results in a carbon intensity (CI) of 19 kgCO<sub>2</sub> equivalent per kg of hydrogen (H<sub>2</sub>) and extracting it from natural gas results in a CI of 12 kg CO<sub>2</sub>e/kg H<sub>2</sub>. In comparison, making hydrogen from renewable energy results in a CI of 0 to 0.6 kg CO<sub>2</sub>e/kg H<sub>2</sub>.

**Backup Power:** In addition to vehicles, fuel cells can also be used to provide backup power when the electrical grid has an outage. Most hospitals, emergency facilities, utilities, data centers and other critical infrastructure rely on polluting diesel generators for backup power. Zero emission fuel cells can replace these carbon intensive options.

**Industrial Processes:** Renewable hydrogen has been identified as a possible solution for decarbonizing the steel, glass, cement and other “hard to abate” sectors. They are hard to abate because these industrial processes cannot be easily electrified. In many situations, renewable hydrogen would replace natural gas as the source of the heat needed to manufacture these products.

**Power Generation:** A few utilities are looking at the possibility of converting shut down coal or existing natural gas plants to clean hydrogen to generate electricity.

## Safety

Safety considerations for hydrogen are similar to those for other flammable gases and fuels like natural gas, propane, and butane. Hydrogen is highly flammable, but also non-toxic, colorless, and odorless. Higher pressures in hydrogen vehicles and fueling stations have enhanced safety precautions such as two-way communication between the fueling pump and vehicle fuel tank, along with sensitive leak detection and monitoring.

The United States currently handles ten million metric tons of hydrogen per year, as safely if not more so, than other fuels. The benefit of hydrogen over other dense flammable gases is that if there is a leak in an uncontained area, hydrogen will rise and disperse into the atmosphere at 44 miles per hour making it much less likely to be an ignition risk.

## Water

Production of renewable hydrogen uses modest amounts of water compared with other fuels. Roughly four gallons of water are needed to make a kilogram of hydrogen, about half the water used to make an equivalent amount of gasoline for transportation.

Some of the water from electrolysis is returned immediately as process water, with minerals at higher concentrations than the supply water, but with no added impurities. One-half to two-thirds of the water used in production is regenerated when hydrogen is consumed at the point of use, released as pure water through vehicle tailpipes or collection systems (about 1 cup of water/mi in a passenger vehicle).

## More Information

Please visit our website for more information about renewable hydrogen and membership in RHA: [www.renewableh2.org](http://www.renewableh2.org)