

# Green Hydrogen

## What Is It?

Green Hydrogen refers to the **production of hydrogen from electrolysis**. Electrolysis uses electricity to split the hydrogen (H) atoms out of water (H<sub>2</sub>O) molecules. This method results in very few direct emissions, but does require significant electricity.



## How Clean is it?

Electrolysis requires about 50 kWh of electricity per kg of hydrogen produced. By using renewable energy sources, green hydrogen creates approximately 1-2 kg of carbon dioxide per kg of hydrogen. It is among the lowest emitting methods of producing hydrogen.



## What Does It Cost?

Green Hydrogen has high upfront production costs, including electricity demand, renewable power sources, and infrastructure. It may cost more than four times as much as traditional high-emitting hydrogen production methods.



## Space



Green hydrogen requires significant industrial, pipeline and energy infrastructure. However, it currently represents only a small fraction of the total hydrogen production.

## Point

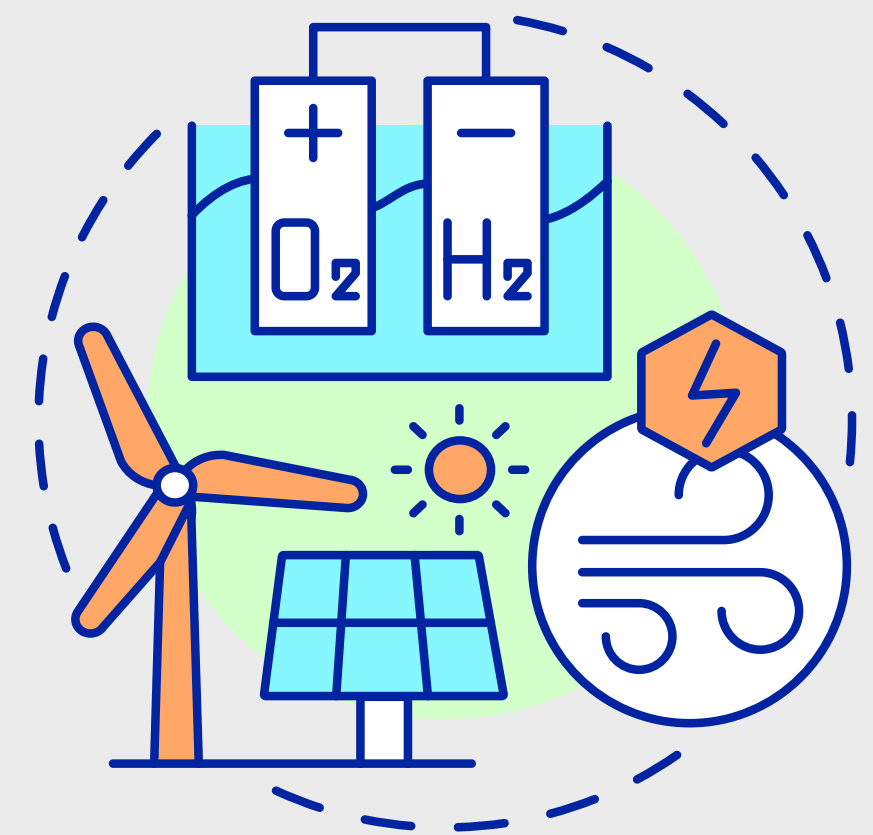
- Green hydrogen is a very low-carbon source of hydrogen.
- Green hydrogen can play a key role in reducing carbon emissions by replacing hydrocarbons in various applications.
- Green hydrogen is highly versatile and can be used in transportation, industrial processes, and power generation.
- Green hydrogen offers an effective solution for energy storage, as it can store surplus renewable energy for use when demand is high.
- Green hydrogen can support decarbonization of the steel and cement industries, which are challenging to power using electricity alone.

## Counterpoint

- ↔ ○ Green hydrogen requires new renewable infrastructure, which have mining and manufacturing emissions and waste.
- ↔ ○ The production process for green hydrogen remains costly and energy-intensive, making it challenging to compete with cheaper energy sources.
- ↔ ○ Storing and transporting hydrogen to its end users is complicated and costly because of its low density.
- ↔ ○ The process of converting electricity to hydrogen and back to electricity is relatively inefficient, resulting in energy losses.
- ↔ ○ Demand must be in place before sufficient investment in green hydrogen will make it economically efficient for businesses. Many industrial energy users do not currently demand hydrogen.

## How Does It Work?

1. Renewable energy sources, such as solar panels or wind turbines, generate electricity. This electricity must be low-carbon and renewable to qualify the hydrogen as "green."
2. The renewable electricity powers an electrolyzer, a device that splits water (H<sub>2</sub>O) into hydrogen (H<sub>2</sub>) and oxygen (O<sub>2</sub>) through an electrochemical reaction. This process releases only hydrogen gas and oxygen, with no direct carbon emissions.
3. The hydrogen gas produced during electrolysis is collected and stored. Hydrogen is highly versatile and can be stored in pressurized tanks or liquefied.
4. The stored hydrogen is transported to where it will be used. This may involve pipelines, specially-designed tanker trucks, or on-site storage if it will be used close to the production site.
5. The hydrogen product can be used in various applications, including as fuel in hydrogen fuel cells for vehicles, as a clean energy source for industrial processes, or as a means of generating electricity in power plants.



## Did You Know?

If the electricity used in electrolysis to produce hydrogen comes from nuclear power instead of other renewables (wind, solar, hydro, etc.), it is called "Pink Hydrogen".

## What's Next?

To be adopted at scale, green hydrogen needs a massive buildout of renewable energy sources. Currently, the lack of sufficient renewable energy is also keeping costs high. Energy abundance, along with supporting infrastructure, is needed to fully utilize green hydrogen.