Gray Hydrogen

What Is It?

Gray hydrogen refers to the production of hydrogen using Steam Methane Reforming (SMR). SMR uses high-temperature steam and natural gas over a catalyst to produce hydrogen, which also produces carbon dioxide.

How Clean is it?

Gray hydrogen is the most popular form of hydrogen production, and produces significant carbon emission. SMR produces around 9 to 12 kg of CO_2 for every kg of hydrogen.

What Does It Cost?

Gray hydrogen is the cheapest and most popular hydrogen production method in the United States, costing roughly $1 - 1.5 per kg of hydrogen.

Space

Gray Hydrogen is produced in large facilities, often times close to the point of use. Approximately 5,000 miles of hydrogen pipelines help transport it to its final point-of use.

Point

- Gray hydrogen is currently the most cost-effective form of hydrogen, and is utilized by many different industries.
- The infrastructure for producing and distributing gray hydrogen is already well-established.
- Gray hydrogen can serve as a transitional resource to boost demand while clean hydrogen technologies are further developed and scaled.
- The process for producing gray hydrogen, steam methane reforming (SMR), is a mature technology.
- The production of gray hydrogen has lower upfront costs than other low-carbon processes, making it attractive for industry.

Counterpoint

- Despite its lower cost, gray hydrogen is produced through a method that results in significant CO_2 emissions.
- Infrastructure investments will still be needed if hydrogen continues to gain popularity for industrial and energy processes.
- Relying on gray hydrogen as a “transition” would not reduce emissions in the short term, as it is still carbon-intensive compared to other production techniques
- Retrofitting existing SMR plants with carbon capture technology is both costly and technically challenging.
- Although it is cheaper initially, gray hydrogen's environmental impact could lead to long-term costs, including risk from future policy changes.

How Does It Work?

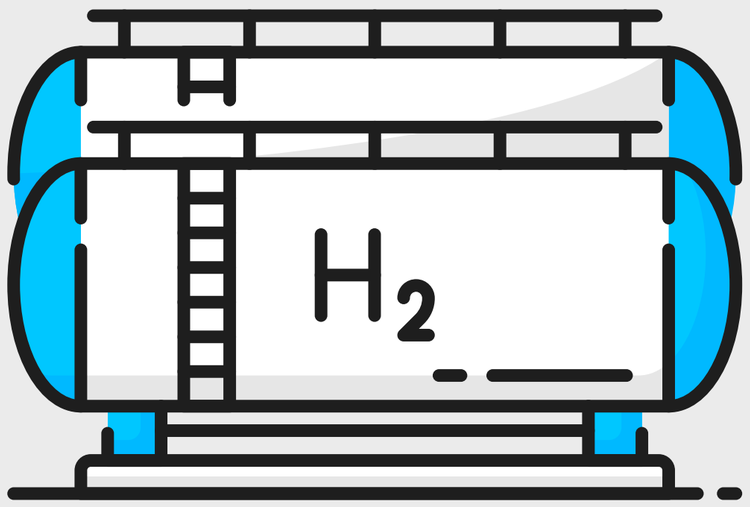
1. Natural gas, primarily methane (CH_4), is extracted from the ground using drilling techniques. This methane is the main feedstock for producing gray hydrogen.

2. The methane undergoes a process called steam methane reforming, where it is heated with steam at high temperatures (700–1,000°C) in the presence of a catalyst. This process breaks down the methane, producing hydrogen gas (H_2) and carbon monoxide (CO).

3. The carbon monoxide produced in the SMR process is then reacted with additional steam in a water-gas shift reaction, which further produces hydrogen and carbon dioxide (CO_2).

4. The hydrogen gas is separated and purified, removing impurities to make it suitable for use in various applications, such as industrial processes or as a fuel source.

5. Carbon dioxide is released into the atmosphere, while the hydrogen is moved through pipelines or liquified for transport. Hydrogen may be used in many industrial applications or even as a transportation fuel.



Did You Know?

Gray hydrogen production accounts for the majority of global hydrogen production — nearly 95%. Because it is derived from natural gas, gray hydrogen is cheap and readily available.

What's Next?

Gray Hydrogen is cheaper than other production techniques, but is disfavored by policy focused on decarbonization. While innovation may cause a shift in color designation (such as CCS turning Gray Hydrogen into Blue Hydrogen) use of renewable natural gas can decrease net emissions.