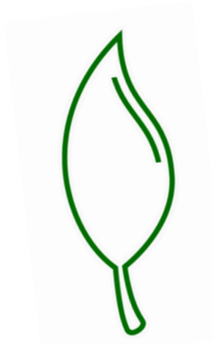
Blue Hydrogen

What Is It?

Blue Hydrogen refers to the production of hydrogen using Steam Methane Reforming (SMR) or Autothermal Reforming (ATR) and capturing the CO_2 emissions for storage using Carbon Capture and Storage (CCS) technology.

How Clean is it?



Blue Hydrogen is much cleaner than regular SMR (Gray Hydrogen) but it still results in some emissions. Between 3 and 8 kg of CO_2 are released for every one kg of hydrogen produced, depending on the technique and technology.

What Does It Cost?

Blue Hydrogen is more expensive than traditional SMR, due to the CCS. However, it is much cheaper than other forms of clean hydrogen production, and may become competitive with incentives.

Space

Blue Hydrogen facilities are similar to traditional SMR hydrogen facilities, except added infrastructure is needed to store and transport the CO_2. CO_2 is most effectively stored underground in regions with specific geology.

Point		Counterpoint
• Blue hydrogen significantly reduces CO_2 emissions by using carbon capture and storage (CCS) technology.	⟷	○ Carbon capture is not 100% efficient, meaning that some CO_2 still escapes into the atmosphere.
• Blue hydrogen leverages existing natural gas infrastructure, making it more feasible to scale up quickly.	⟷	○ Although some existing infrastructure can be used, more CO_2 infrastructure will be needed to facilitate carbon dioxide transportation and storage.
• Blue hydrogen is more cost-effective than other low-carbon production methods.	⟷	○ The costs of CCS, coupled with potential carbon taxes, may make blue hydrogen less economically viable in the long run.
• Blue hydrogen can be produced consistently, regardless of weather conditions, unlike green hydrogen which depends on variable renewable energy sources.	⟷	○ Storage of CO_2 can be dependent upon regional geology, making it more difficult to produce blue hydrogen in certain areas.
• CCS technology advancements can improve blue hydrogen's sustainability, capturing and storing more carbon.	⟷	○ Some blue hydrogen processes may not qualify for government tax credits because it still has higher emissions than other hydrogen sources.

How Does It Work?

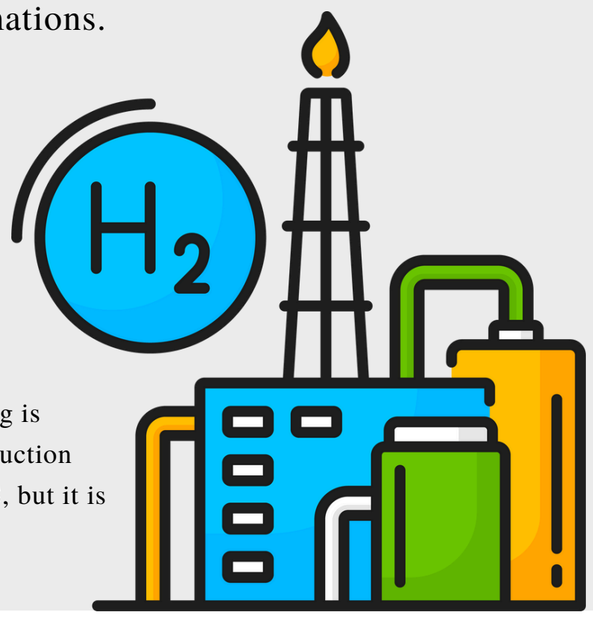
1. Natural gas, primarily methane (CH_4), is extracted from the ground using drilling techniques. This methane is the main feedstock for producing blue hydrogen.

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. The CO_2 generated during the SMR and water-gas shift reactions is captured instead of being released into the atmosphere. This captured CO_2 is then compressed and transported to storage facilities, typically underground geological formations.



*this refers to blue hydrogen using Steam Methane Reforming. Autothermal Reforming is another hydrogen production method used with CCS, but it is less common.

Did You Know?

Blue hydrogen production can use captured CO_2 for enhanced oil recovery (EOR), helping offset some production costs. In EOR, captured CO_2 is injected into oil fields to increase oil extraction efficiency.

What's Next?

The future of blue hydrogen will likely involve advancements in carbon capture technology to maximize emission reductions. Blue hydrogen could play a critical role in decarbonizing hard-to-abate industries and providing low-carbon energy where natural gas infrastructure is already in place.