

Turquoise Hydrogen

What Is It?

Turquoise Hydrogen is the **production of hydrogen using Methane Pyrolysis**. It is a low-carbon production technique, that utilizes natural gas. Instead of releasing CO₂ emissions, it generates hydrogen gas and a solid carbon byproduct.



How Clean is it?

Methane Pyrolysis mainly creates solid carbon byproduct that can be stored or utilized, but does release some small CO₂ emissions, depending on the technique. Emissions are around 1 - 2 kg of CO₂ per kg of hydrogen.



What Does It Cost?

Turquoise hydrogen costs vary, but are generally more expensive than gray or blue hydrogen. It also produces solid carbon as a byproduct, which can be sold to offset some of the added production costs.



How Does It Work?

1. Natural gas, primarily methane (CH₄), is extracted from the ground using drilling techniques. This methane is the main feedstock for producing Turquoise hydrogen.
2. The methane is fed into a high-temperature pyrolysis reactor, which operates at temperatures above 1,000°C. This reactor is specifically designed to break down methane without the need for oxygen or air.
3. Inside the pyrolysis reactor, methane undergoes thermal decomposition. This process splits methane into two products: hydrogen gas (H₂) and solid carbon (C).
4. The hydrogen gas produced is collected and separated, purified as needed, and made ready for storage or transport.
5. The solid carbon produced in the process is collected as a byproduct. This carbon can be stored, sold, or used in various industrial applications, such as in construction materials or manufacturing.



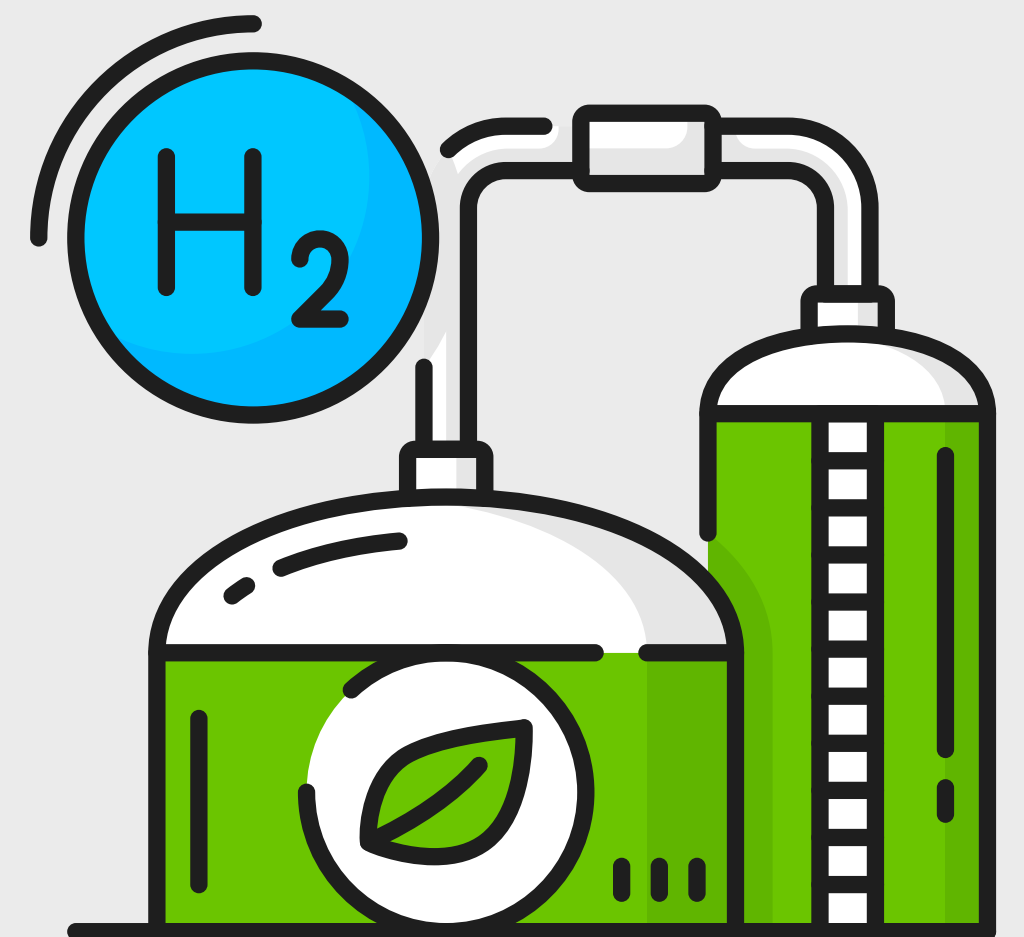
Turquoise hydrogen can leverage distributed production and utilize existing natural gas infrastructure. The solid carbon byproduct must also be stored, and it can be sold for other industrial processes or products. Its overall footprint is low.

Point

- Turquoise hydrogen produces solid carbon as a byproduct, avoiding CO₂ emissions during production.
- The production process for turquoise hydrogen, is much more energy efficient than green hydrogen.
- Solid carbon produced from turquoise hydrogen can be used in manufacturing tires, batteries, and construction materials.
- Methane pyrolysis technology is advancing very quickly.
- Turquoise hydrogen has the potential to be an economically viable hydrogen option in industries seeking cleaner alternatives to traditional hydrogen.

Counterpoint

- Managing and storing solid carbon at scale can present logistical challenges, and demand for carbon is not well established.
- Methane pyrolysis still relies on natural gas as a feedstock, which can lead to methane emissions during extraction and transport.
- The demand for solid carbon is limited, and oversupply could lead to disposal issues, especially if production scales up significantly.
- Methane pyrolysis is still in the early stages of commercial development, and scaling up for widespread adoption will require significant investment.
- The capital cost of methane pyrolysis plants are quite high, and significant infrastructure investment will be needed.



Did You Know?

Turquoise hydrogen production can be "carbon-negative" when paired with bio-methane. Using bio-methane (methane derived from organic waste also known as Renewable Natural Gas) as the feedstock, the carbon captured as a solid byproduct effectively removes CO₂ from the carbon cycle.

What's Next?

The future of turquoise hydrogen lies in scaling up methane pyrolysis technology and identifying markets for solid carbon. Companies are currently making turquoise hydrogen production modular and scalable, while carbon is viewed as a "co-product" and utilized in electric vehicle battery manufacturing, asphalt, and more.