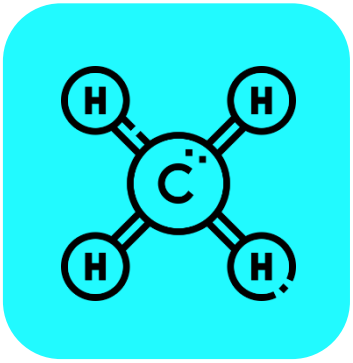
Turquoise Hydrogen

An Advanced Approach to Carbon-Free Hydrogen Production

Introduction:



Any Biomas such as Sugar Factory byproduct 'Pressmud', is a resource with methane content which can be used for production of Methane-Rich Biogas with upto ~ 55-65% Methane content in it. When this methane rich biogas is reacted chemically in absence of Oxygen using to specialised technology called as 'Methane Pyrolysis', Turquoise Hydrogen is produced. 'Turquoise Hydrogen' is a name/designation given to hydrogen gas that is produced using Pyrolysis technology. In this report we have briefly discussed about the technology, key features, Hydrogen use cases & its applications.

Methane Pyrolysis Technology

Methane pyrolysis is a promising technology for producing hydrogen in a way that minimizes carbon emissions. Hydrogen has become a critical energy carrier in the transition to clean energy systems, and finding efficient methods to produce it without releasing harmful byproducts is a pressing global challenge. Methane pyrolysis offers a unique solution to this problem by using methane as a feedstock and generating solid carbon as a byproduct, rather than emitting carbon dioxide. This process is increasingly gaining attention for its potential to revolutionize energy and industrial sectors.

Methane pyrolysis is a thermal decomposition process in which methane (CH_4) is heated to high temperatures in the absence of oxygen. This reaction breaks apart the methane molecule into its elemental constituents: hydrogen (H_2) and solid carbon (C). The reaction can be represented by the following equation: $CH_4 \rightarrow C + 2H_2$

The end result is the separation of methane into clean hydrogen gas and solid carbon. Since no oxygen is present in the process, carbon dioxide (CO_2), the primary greenhouse gas associated with conventional hydrogen production methods, is avoided.

Key Features of Methane Pyrolysis

Energy Efficiency

Methane pyrolysis is considered more energy-efficient compared to other methods of hydrogen production. Consumes just 10–15 kWh of electricity per kg of hydrogen produced.

No Direct CO_2 Emissions

Conventional hydrogen production methods, such as steam methane reforming (SMR), generate large amounts of CO_2. Methane pyrolysis, on the other hand, avoids this by converting the carbon in methane into solid form, thus presenting a carbon-free alternative.

Turquoise Hydrogen Production Life-Cycle

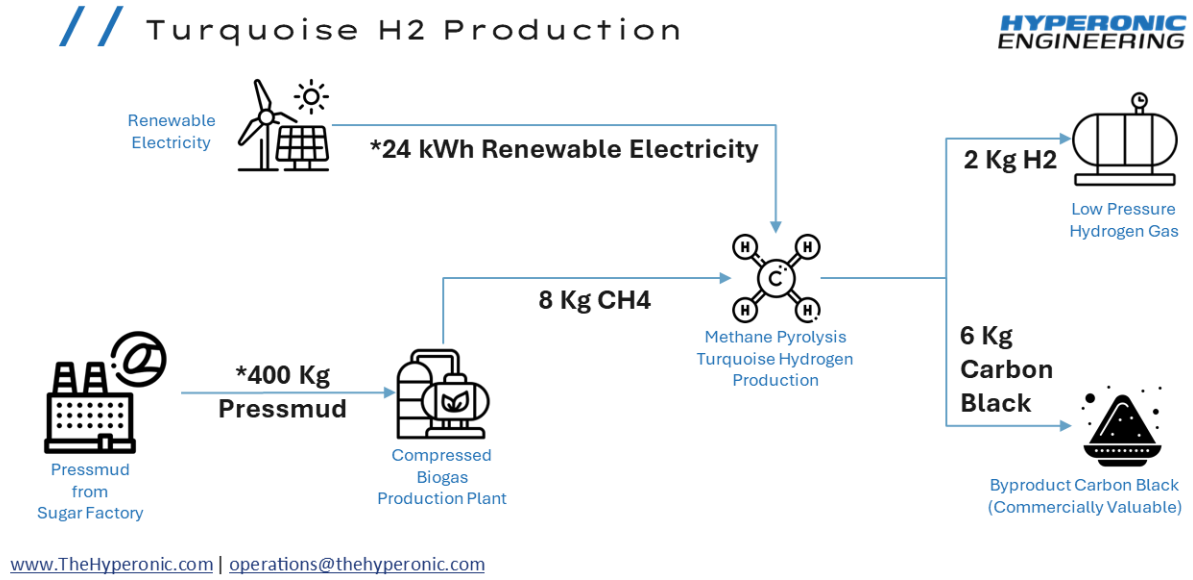


Fig.1: Example Turquoise Hydrogen Production Process

Hydrogen Gas Use Cases:

Hydrogen gas emerges as a pivotal element in industrial innovation, offering a cleaner energy source and facilitating significant reductions in greenhouse gas emissions across various applications as depicted in below infographic.

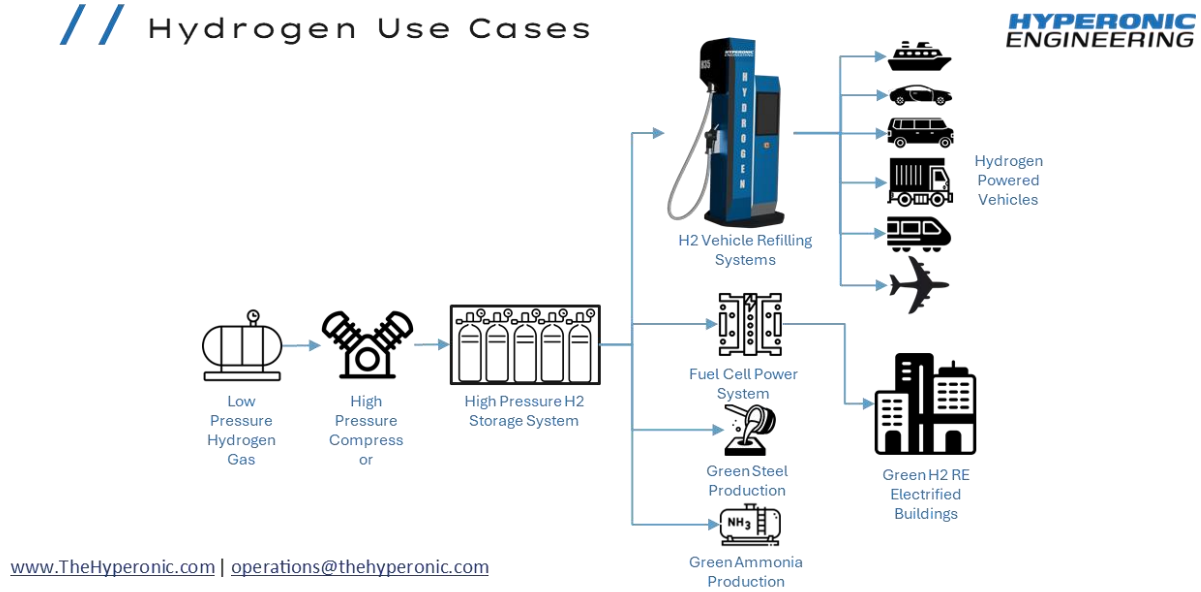


Fig.2: Example Use cases of Hydrogen Gas Into Various Industrial Applications

Applications of Turquoise Hydrogen

Turquoise Hydrogen offers versatile use cases that align with sustainability goals and industrial advancements. Below are some of its key applications:

- **Sustainable Mobility:** Turquoise hydrogen with purity levels more than 99.997% can be used a fuel for hydrogen powered vehicles which emit water vapours as exhaust and have benefit zero carbon aspects of EVs as well as fast refilling times like regular IC vehicles.
- **Industrial Decarbonization:** Turquoise hydrogen serves as a cleaner energy source for industrial applications, replacing fossil fuels in processes that require high heat or hydrogen feedstock, thereby reducing greenhouse gas emissions.
- **Decarbonization of Natural Gas:** Methane pyrolysis offers a pathway for utilizing natural gas reserves sustainably, allowing for the extraction of hydrogen without contributing to greenhouse gas emissions.
- **Carbon Fiber and Advanced Composites:** The carbon produced can be used to manufacture carbon fibers and composite materials, which are essential in industries such as automotive, aerospace, and sports equipment for their lightweight and high-strength properties.
- **Energy Storage and Batteries:** The solid carbon byproduct from methane pyrolysis can be utilized in the production of battery electrodes, contributing to the development of high-performance energy storage solutions.

Note: *Data presented in this report is based on research and information available at the time of research. Presented numbers may differ based on performance optimization by individual product OEMs and project development strategies. This report intends to share basic information for academic purposes.

If you are interested in performing techno-economic assessment or to execute any category of hydrogen eco-system projects, our team is ready & will be happy to support you in entire project lifecycle i.e. from ideation to execution stages. Please feel free to connect with us at operations@thehyperonic.com.

- Team Hyperonic Engineering Pvt. Ltd.