

# Climate SAR

Climate Science And Research

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Climate Change and Hydrogen



**Climate Change Research Institute**

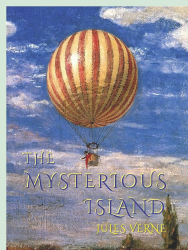
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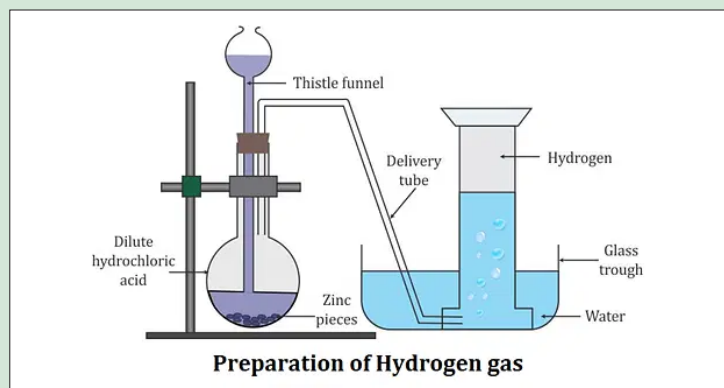
# HYDROGEN

**Hydrogen was first discovered by British scientist Henry Cavendish in 1766.**



**Hydrogen has been in the public imagination since the 1870s, when Jules Verne wrote novel 'The Mysterious Island'. He envisioned a place where water (hydrogen) is the source of energy.**

**Hydrogen gas can be prepared in your homes or in the laboratory by reacting dilute hydrochloric acid with granulated zinc. The following is the chemical reaction:**



## From Editor



*Hydrogen is the lightest chemical element and the most abundant chemical substance in the universe. Unlike most fuels, hydrogen does not produce the carbon dioxide (CO<sub>2</sub>) when burnt. Its combustion product is water. This means that burning hydrogen fuel does not contribute to global warming and climate change.*

*The Intergovernmental Panel on Climate Change (IPCC) has stated, "If the world to reach net zero emissions, hydrogen will play a vital role". To achieve a target of net zero emission, a hydrogen based economy can make a great impact.*

*In this issue you learn about why hydrogen, its colors and India's Green Hydrogen Mission. The green hydrogen plants being built and tips for hydrogen safety are described.*

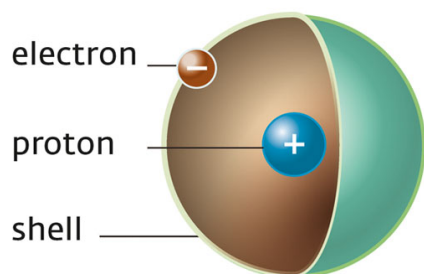
*Please do send your feedback at [contactus@ccri.in](mailto:contactus@ccri.in)*

*Happy Reading!*

**Dr. (Mrs.) Malti Goel**  
President and Chief Executive  
Climate Change Research Institute

## WHAT IS HYDROGEN?

Hydrogen is the lightest and most abundant element in the universe, constituting roughly 75% of its elemental mass. It's a colorless, odorless, and highly flammable gas in its pure form. In the periodic table, hydrogen is the first element having one proton in its nucleus.



## WHERE HYDROGEN IS FOUND?

Hydrogen makes up less than 1 percent of Earth's crust and is a trace gas in the Earth's atmosphere. It is in the tissues of all plants and animals and in petroleum and other energy fuels. Hydrogen is also found in most stars, including the sun. Hydrogen is produced when electric current is passed through water. Water splits it into elemental oxygen and hydrogen through a process called electrolysis.

## PROPERTIES AND USES

Hydrogen is part of so many things because it is highly chemically reactive. It combines well with other elements, particularly

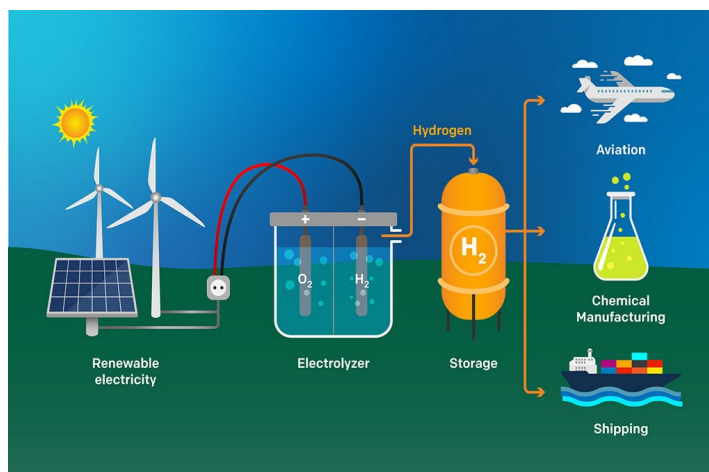
carbon. The main use of hydrogen on Earth is to make ammonia. Hydrogen is also used in a process called hydrogenation. This process changes vegetable oils to solid fats for making margarine and cooking fats.

## WHAT IS GREEN HYDROGEN?

Green hydrogen is a super eco-friendly version of hydrogen, and it's getting a lot of attention because it can drive clean energy transition.

Green hydrogen is made by electrolysis of water using electricity renewable energy, like solar or wind power.

Green hydrogen is one of the cleanest sources of energy with close to zero emission. It can replace fossil fuels in high energy consuming industries like Steel, Chemicals and Fertilizers. It can be used in fuel cells for cars.



# AWARENESS AND CAPACITY BUILDING WORKSHOP ON HYDROGEN

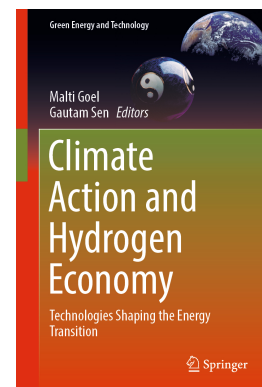
The Climate Change Research Institute (CCRI) organised the workshop on 'Awareness and Capacity Building in Hydrogen Production and Energy Use: Towards a Net zero Strategy (ACBHPE-2022)' on the World Environment Day 2022.

## Key highlights

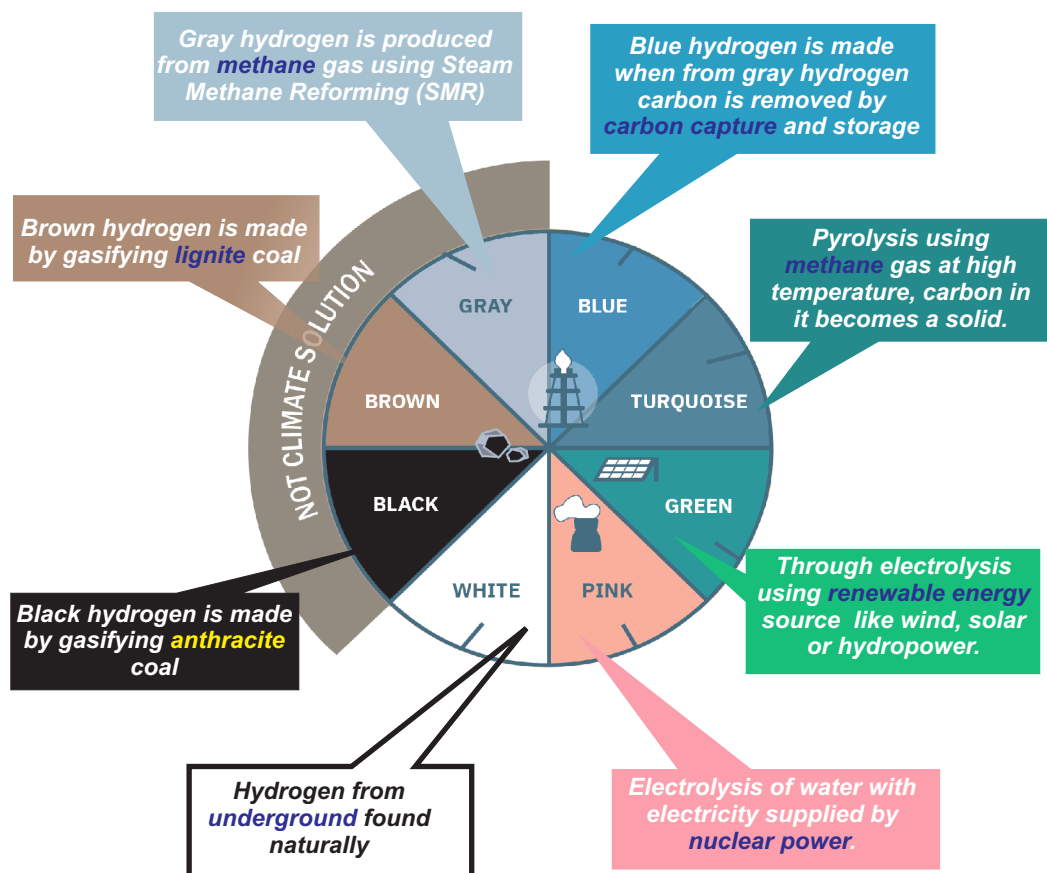
★ ACBHPE - 2022 workshop was held from 8 – 10th June 2022 in association with the IIC Delhi and partially supported by the SERB, Government of India.

★ The three-day workshop conducted in 'hybrid mode' aimed to examine the critical technical issues of hydrogen production, its use, and assessments for the current state of R&D and technology

★ A book no 'Climate Action and Hydrogen Economy: Technologies Shaping the Energy Transition' is published in Green Energy and Technology Series of Springer



## COLOURS OF HYDROGEN



Source: <https://climate.mit.edu/explainers/hydrogen>

The Gender mainstreaming in the ACBHPE-2022 workshop as a strategy by inviting women scientist to participate as delegates and contribute as authors in the book has been encouraged.



# NATIONAL GREEN HYDROGEN MISSION (NGHM)

The NGHM is launched by the Government of India in January 2023. The Mission will facilitate demand, production, utilization and export of Green Hydrogen, and creation of Jobs. It is a program to incentivise the commercial production of green hydrogen and make India a net exporter of the fuel.

Green hydrogen has become a possible solution to climate action. Countries across the world are working on building green hydrogen capacity as it can ensure energy security and also help in cutting carbon emission.

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*“To make India the Global Hub for production, usage and export of Green Hydrogen and its derivatives. This will contribute to India’s aim to become Aatmanirbhar through clean energy and serve as an inspiration for the global Clean Energy Transition. The Mission will lead to significant decarbonisation of the economy, reduced dependence on fossil fuel imports, and enable India to assume technology and market leadership in Green Hydrogen.”*

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## Green Hydrogen Hubs:

States and regions capable of supporting large scale production and/or utilization of hydrogen will be identified and developed as Green Hydrogen Hubs.

## SIGHT Programme:

The Strategic Interventions for Green Hydrogen Transition (SIGHT) programme will fund the domestic manufacturing of electrolyzers and produce green hydrogen.



# INDIA'S GREEN HYDROGEN PLANTS

**Oil India Limited (OIL)** took the first significant step towards Green Hydrogen Economy in India with the commissioning of India's First 99.999% pure Green Hydrogen pilot plant, with an installed capacity of 10 kg per day at its Jorhat Pump Station in Assam in April 2022.

The plant produces Green Hydrogen from the electricity generated by the existing 500kW Solar plant using a 100 kW Anion Exchange Membrane (AEM) Electrolyser array.

Oil India Ltd. plans to set up a green hydrogen valley in the Northeast in partnership with the IIT Gwahati.



Oil India Ltd. plant in Jorhat

**Nathpa Jhakri Hydro Power Station (NJHPS)** in Himachal Pradesh has built a green hydrogen pilot with 20Nm<sup>3</sup>/hr electrolyzer and 25kW fuel cell capacity. The plant was inaugurated in April 2024.

The project is the nation's first multi-purpose (combined heat and power) green hydrogen generation plant producing 14 kg hydrogen gas with the capability to cater to the high-velocity oxygen fuel (HVOF) coating facility of NJHPS to meet its combustion fuel requirements, in addition to generating electricity through its 25kW capacity fuel cell.



Nathpa Jhakri green hydrogen plant in H.P



# HYDROGEN SAFETY

Hydrogen gas is highly flammable causes fire and explosions. Safety from hydrogen use is an important consideration. Safety requirements for use of



hydrogen gas in industrial settings are highest, and general precautions are must when hydrogen is in use.

**Hydrogen safely rules to be practiced for use and storage are;**

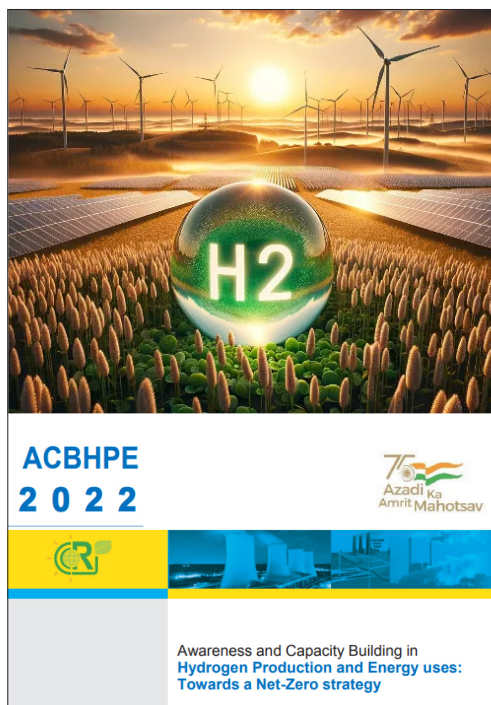
- ★ Safe use of hydrogen focuses on avoiding situations where all the three combustion factors—ignition source (spark or heat), oxidant (air), and hydrogen (fuel)—are present.
- ★ Storing and using with adequate ventilation
- ★ Storing only where temperature will not exceed 125°F (52°C).
- ★ Using a barricade of at least 5 ft made of noncombustible material when stored with other cylinders of oxygen, chlorine, and other oxidizers
- ★ Liquid hydrogen requires more precaution due to increased density and extremely low temperature needed to store it.



**On the other hand a number of hydrogen's properties that make it safer to use than other fuels:**

- Hydrogen is non-toxic gas
- It is much lighter than air; therefore it dissipates rapidly when released or leaked
- Hydrogen is clean gas causes no pollution in air





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