

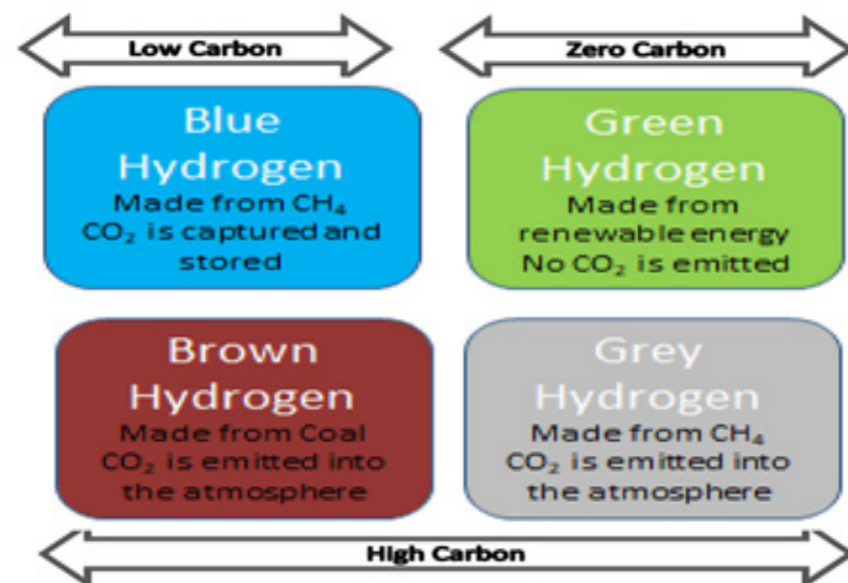
GREEN HYDROGEN, THE FUEL OF FUTURE

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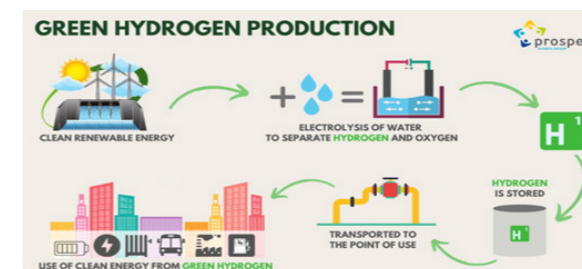
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- Hydrogen is one of the most abundant elements on earth for a cleaner alternative fuel option.
- **Type of hydrogen depend up on the process of its formation:**
- Green hydrogen is produced by electrolysis of water using renewable energy (like Solar, Wind) and has a lower carbon footprint.
- Electricity splits water into hydrogen and oxygen.
- By Products: Water, Water Vapor.
- Brown hydrogen is produced using coal where the emissions are released to the air.
- Grey hydrogen is produced from natural gas where the associated emissions are released to the air.
- Blue hydrogen is produced from natural gas, where the emissions are captured using carbon capture and storage.



WHAT IS GREEN HYDROGEN?

- Green hydrogen is produced with the help of electrolysis through electricity generated from renewable sources of energy such as solar and wind.
- An electric current then splits the water into hydrogen and oxygen.
- This ensures no greenhouse gas emissions as the only byproduct of this process is oxygen, making it a great replacement for carbon emitting fuels.



WHY GREEN HYDROGEN IS NEEDED?

- Hydrogen has numerous uses starting from industrial purposes to fulfilling domestic energy requirements.
- Approximately 70 million metric tons of hydrogen are already produced globally every year for use in oil refining, ammonia production, steel manufacturing, chemical and fertilizer production, food processing, metallurgy, and more.
- However, various estimates say that hydrogen production for these usages is currently responsible for more than 2 % of total global CO₂ emissions.
- As per International Energy Agency (IEA), 2019 estimates, global energy demand will

increase by between 25 % and 30 % by 2040, which will further raise greenhouse gas emissions.

- This will aggravate environmental degradation and exacerbate climate change further.
- On the contrary, the global plan is to decarbonise the planet by 2050.
- Given this scenario, green hydrogen can prove to be the best alternative.

USES OF GREEN HYDROGEN

Industrial

- Hydrogen is used mainly in the chemical and petrochemical industry. In the last few years, it is also being used in the steel industry.
- Green hydrogen can prove to be a better alternative in these industrial sectors.

Domestic

- For domestic usage regarding heating and electricity, green hydrogen can replace natural gas and help in reducing greenhouse gas emissions.
- It can be also stored in existing pipelines to power various domestic appliances.

Fuel cells

- One of the most discussed areas for the usage of green hydrogen is its use in fuel cells. These fuel cells are well-known for their energy efficiency.
- Fuel cells can be used as an alternative fuel in electronic vehicles.
- Fuel cells may also help run electronic devices.



CHALLENGES

- The major challenge in the electrolysis of water using renewable energy is the cost, particularly, the cost of the electrolyser (the device that splits water).
- Only a handful of Indian companies manufacture electrolysers.
- According to The Energy and Resources Institute (TERI), the cost of green hydrogen production is \$5-\$6 per kg.
- Another challenge is the efficiency of the electrolysers i.e. how much electricity it consumes to produce a kg of hydrogen.
- Today, it is 55 kWhr per kg of hydrogen.
- Absence of dedicated government policy and lack of public awareness have been significant barriers in India's hydrogen economy.



WHAT STEPS HAVE BEEN TAKEN TO BOOST GREEN HYDROGEN IN INDIA?

- Ministry of New and Renewable Energy (MNRE) has been supporting a broad based R&D programme on Hydrogen Energy and Fuel.
- With respect to transportation, major work has been supported to Banaras Hindu University, IIT Delhi, and Mahindra & Mahindra resulting in the development of internal combustion engines and vehicles that run on hydrogen fuel.
- Two hydrogen refuelling stations have been established (one each at Indian Oil R&D Centre, Faridabad and National Institute of Solar Energy, Gurugram).
- India has already taken the first step with the Indian Oil Corporation floating a global tender to set up two green hydrogen generations units at the Mathura and Panipat refineries.
- National Hydrogen Energy Mission which was proposed in the Budget Speech 2021-22 aims to develop India into a global hub for manufacturing of hydrogen and fuel cells technologies across the value chain.
- A production linked incentive (PLI) scheme was announced in the budget 2021-22.
- National Hydrogen Energy Mission document was drafted by MNRE to scale up Green Hydrogen production and utilization across multiple sectors, including transportation