Green Hydrogen Emerging as Auto-Fuel

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Abstract – **India is world's third biggest emitter of greenhouse gases, with only China and USA ahead of it. The Energy and Resources Institute recently highlighted potential of green hydrogen --the cleanest form of energy to decarbonise economy.**

Hydrogen can be produced from a variety of sources, such as natural gas, biomass, and renewable power like solar and wind. It can be used in cars, in houses, for portable power and in other applications. During past six years, India increased its renewable power segment from 32 GW to 100 GW and is poised to achieve the target of 450 GW generating capacity by 2030.

Green hydrogen is derived from water electrolysis using renewable energy. It can replace CO_2-emitting conventional fuels like petrol and diesel, thus helping to meet United Nation's Sustainable goals. Both private and public sector companies are taking active interest. For instance, National Thermal Power Corporation is working to set up India's first green hydrogen fueling station in Leh, Ladakh.

India spends $160 billion importing fossil fuel products, hydrogen has the potential to significantly reduce import dependence. Green hydrogen has the promise of transforming India from an energy-deficient to an energy-rich country.

Keywords: Green hydrogen, Decarbonising economy, UN Sustainable goals, Renewable energy, Fuel of the future

I. INTRODUCTION

ENVIRONMENT degradation caused by widespread use of fossil fuels is playing havoc with our lives, causing climate change leading to high-intensity rainfalls, hurricanes, landslides and glaciers-melting. In such a scenario, renewable energy holds the hope. Now a new entity appears on the horizon.

Its name is Green hydrogen, a product derived from water electrolysis using renewable energy such as solar or wind and can partly replace petrol and diesel, the carbon-emitting fuels. At present, hydrogen used in India comes from fossil fuels. However, by 2050, three-fourth of all hydrogen is projected to be green.

Hydrogen has the promise of transforming India from an energy-deficient to an energy-rich country. Hydrogen is considered one of the most sustainable fuels of the future. When you burn it, you get water vapour, with no residue or climate-harming impact.

Green hydrogen is produced using renewable energy and electrolysis to split water and is distinct from grey hydrogen, which is produced from methane and releases greenhouse gases into the atmosphere, and blue hydrogen, which captures those emissions and stores them underground to prevent them causing climate change.

Green hydrogen could supply up to 25% of the world's energy needs by 2050 and become a $10 trillion market by 2050. This will help to limit global temperature rises to 1.5°C.

Green hydrogen is a better alternative to EVs. Vehicles powered by green hydrogen fuel will have a faster refueling time as compared to EVs that take more time to get charged. It is also a cleaner alternative as its method of generation uses renewable resources whereas the electricity is still generated using fossil fuels.

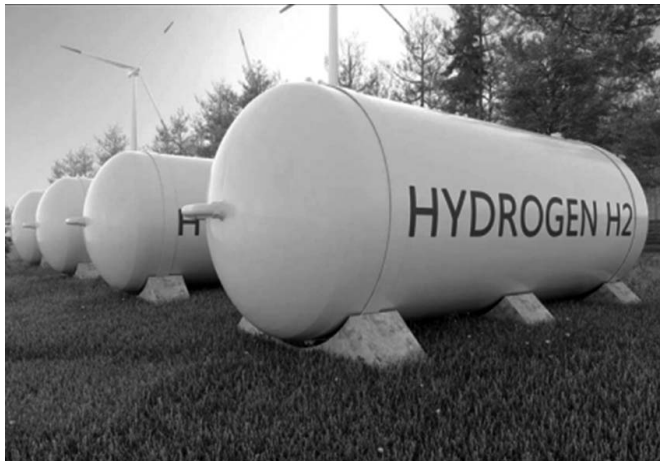

Figure 1. India's first green hydrogen electrolyzer gigafactory was launched at Bengaluru by Ohmium International, a US-based renewable energy start-up through its India subsidiary.

Several companies including Reliance, Adani Group, Indian Oil and National Thermal Power Corporation (NTPC) are leading India's mission to adopt green hydrogen. Mukesh Ambani-led Reliance Industries recently announced its hydrogen plans to become a net carbon-zero firm by 2035.

Adani Group announced a partnership with Maire Tecnimont

to develop green hydrogen projects in the country. Indian Oil announced its plans to build a green hydrogen plant at its Mathura refinery. IndianOil has a wind power project in Rajasthan to wheel that power to Mathura refinery to produce green hydrogen through electrolysis. NTPC announced its plans to set up India's first green hydrogen fuelling station in Leh, Ladakh. It proposes to set up a pilot project for blending hydrogen with national gas for use in city gas distribution.

Recently, Fusion Fuel Green — which has offices in Ireland and Portugal — signed an agreement with BGR Energy Systems, an engineering, procurement and construction firm whose corporate headquarters are in Chennai. They will develop green hydrogen projects via a demonstration facility in Cuddalore.

Figure 2. Hydrogen fuel cell vehicles can be charged in 5-15 minutes.

II. A BRIEF GUIDE TO HYDROGEN

Hydrogen can be produced in a number of ways. One method includes using electrolysis, with an electric current splitting water into oxygen and hydrogen. If the electricity used in the process comes from a renewable source such as wind or solar then it's termed "green" or "renewable" hydrogen.

At the moment, the vast majority of hydrogen generation is based on fossil fuels, which in turn has an effect on the environment. According to IEA, hydrogen produced using fossil fuels is responsible for nearly 830 million metric tons of carbon dioxide each year.

So-called "blue hydrogen" refers to hydrogen produced using fossil fuels — usually natural gas — with the associated emissions captured and stored.

The potential of green hydrogen in India was highlighted by a recent report from The Energy and Resources Institute, *The Potential Role of Hydrogen in India*.

A changing landscape: Ministry of Petroleum & Natural Gas signed agreement between Indian Oil and Greenstat Hydrogen India, a subsidiary of Norwegian energy company Greenstat, to establish a Center of Excellence on Hydrogen to promote R&D projects in Green and Blue Hydrogen.

Figure 3. Green hydrogen, produced using renewable energy, could decarbonise energy-intensive industries.

Increasing production of green hydrogen will enable net-zero emissions by 2050 and limit global temperature rises to 1.5◦C.

III. HYDROGEN FOR STORAGE PURPOSE

World Energy Outlook 2020 predicts that battery storage will become a source of power system flexibility. IEA estimates that global investment in this area will be $25 billion by 2030. India is contemplating use of hydrogen technology to store electricity that can run vehicles and balance power systems. This will turn out to be cheaper and more efficient than the lithium-ion batteries. In spite of cost of lithium-ion battery packs falling by 90% from the 2010 level, they are still quite high for power sector. Hydrogen technology is expected to result in cheaper battery storage system besides more reliable by reducing its dependence on vagaries of nature.

IV. GLOBAL INITIATIVES

80 million metric tons of current global production of hydrogen is mostly produced via fossil fuels, using 6% of global natural gas and 2% of coal, emitting 830 million tons of CO_2. Interestingly, USA's initiative to cut cost of producing green hydrogen to <$2/kg, would pave the way to cut emissions from carbon-intensive industries such as steel, shipping, chemicals and power. Over 8,000 hydrogen cars ply on US roads.

Australia, Chile, Germany, the EU, Japan, New Zealand, Portugal, Spain and South Korea published national hydrogen strategies. Over 75 countries announced a goal of net-zero carbon for which hydrogen is the main agency.

Making production-cost of hydrogen competitive with fossil fuels is dependent on rapid and significant scale-up of its production. By 2050, hydrogen could be a $ 2.5 trillion industry with a total workforce of 30 million people.

European Commission is evolving Clean Hydrogen Alliance. Germany is finalizing its national hydrogen strategy. Airbus designed prototypes for a hydrogen fuel passenger aircraft with a timeline for production to 2035. International Renewable Energy Agency organized discussion with industry stakeholders to achieve cost competitiveness of embracing green hydrogen.

Collaborative Framework on Green Hydrogen discussed ways to build a deeper understanding of industry barriers and opportunities, and to form more cohesive and well-informed perspectives.

Due to multiple initiatives, coordination is needed to ensure that definitions and scope are consistent across regions.
It is essential to have harmonious standards and the certification of green hydrogen to enable a global trade.

IRENA aims to be fulcrum of engagement with stakeholders to effectively tackle some of these issues.

V. CONCLUDING REMARKS

In the near future, we are likely to observe an inflexion phenomenon to catapult hydrogen from fringe to mainstream. Realization of Green Hydrogen goal is dependent on several things. First a propitious enabling policy framework; second efforts to increase demand; third infrastructure development, like pipeline networks and last mile connectivity. Proven business models like 'Master Limited Partnerships', common in the West allow private capital to participate in the scaling-up effort.

Dr Ranjit Singh, FIETE (b. 17 Aug 1948) obtained B.Tech, M.Tech. and Ph.D degrees from Indian Institute of Technology, Kanpur in 1969, 1971 and 1975 respectively specializing in the area of Electronic circuits and devices. Has abiding passion for research and innovative approach to teaching. Guided BTech, MTech and PhD scholars. He is founding Editor-in-Chief of the '*AKGEC International Journal of Technology*', which is running in twelfth volume.

Earlier served IETE as Editor during 1975-1987; Technical Editor at *Telematics India* during 1987-2001 and Editor of *Industrial Purchase* journal during 2002-2008.

From September 2008 to February 2015, he taught at Ajay Kumar Garg Engineering College where, he was a Professor in the EC department. Thereafter served as Head of the ECE and EI departments, IEC Engineering College, Greater Noida from April 2015 – May 2016, where he supervised setting up of e-Yantra lab.

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- Security Issues in Wireless Communications (Nov 2016)
- Big Data: Challenges and opportunities (Feb 2017)
- Smart Cities (April 2017)
- Lure of ISM Band (July 2017)
- Lithium Ion Batteries: Answer to Communications Energy Crunch (May 2018).

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