

GREEN HYDROGEN - OPPORTUNITIES IN INDIA



Dr J S Sharma

Co-Chair, Environment Committee, PHDCCI
STA Fellow (Environment), AIST, Govt. of Japan
Formerly Group General Manager and Head
Environment, ONGC, New Delhi

India has a large growing population and economy, but comparatively has limited availability of fossil fuels to fulfill its energy demands. The key point here to consider the ever-increasing fuel demand and its dependency on imported crude oil for domestic needs. India's annual energy import cost is in excess of USD 119.2 billion in 2021. More than 82% of this cost is consumed in importing crude oil and natural gas. To reduce the environmental pollution and petroleum imports in India, there is a need to look for an alternate source of clean energy to meet the requirement. We may look at solar PV and wind which have revolutionized India's green energy sector in the past decade. Diversification of electricity sources by integrating renewable energy in its grid is helping India in achieving the Paris agreement targets. Recently on August 03, 2022, the Union Cabinet, Govt. of India has approved India's Updated Nationally Determined Contribution under the Paris Agreement which is to be communicated to the United Nations Framework Convention on Climate Change. According to the updated NDC, India now stands committed to reducing emissions intensity of its GDP BY 45 per cent by 2030, from 2005 level, and achieving about 50 per cent cumulative electric power installed capacity from non- fossil fuel-based energy resources by 2030. A step forward to meet Net Zero target by 2070.

Green Hydrogen – The National Agenda

Prime Minister in his Independence Day speech (15 ugust,2021) has announced five key initiatives, the first being Mission Hydrogen. He outlined a vision of becoming a global leader and enabling a substantial domestic hydrogen economy. Hydrogen has the promise of transforming India from an energy-deficient to an energy-rich country. It can even make India a net exporter of energy. In February 2022, India made a big splash in the hydrogen ecosystem by announcing its Green Hydrogen Policy. The policy takes ahead the vision articulated by Prime Minister Narendra Modi, to make India the global hub for the production and export of Green Hydrogen. The policy lays out incentives for investors to use this new age fuel and gradually move away from traditional sources of energy.

Hydrogen is considered one of the most sustainable fuels of the future. When hydrogen is burned, we get water vapour, with no residue or climate-harming impact. This has to do with a confluence of factors like declining costs, breakthroughs in technology and carbon taxes, as happened for other renewables. The challenge has been to make “green hydrogen”, which was the thrust of the Prime Minister’s proclamation. For it, a lot of energy for the electrolysis of water is needed. Unless this electricity is produced with a zero-carbon footprint (i.e. with solar or wind), it defeats the key aspect of ‘green’ hydrogen. All other modes that do not use electrolysis to break a molecule of water are methods where hydrogen is produced as a by-product, or through a carbon burning process. Thankfully, India is blessed with all-year sunshine. About 5,000 trillion kWh per year energy is incident over India’s land area with most parts receiving 4-7 kWh per sq. m per day. In India, an average of 300 sunny days a year, the Solar photovoltaics power can effectively be harnessed providing huge scalability in India. This very clearly indicates that there is a very high potential of harnessing the Green Hydrogen energy in India. Solar-to-hydrogen also solves an intermittence problem, as hydrogen substitutes the need for battery storage.

Opportunities for Green Hydrogen

Opportunities for India Based on India’s current progress in the renewable energy sector, it is clear that green hydrogen will make a greater impact on India’s overall energy sector. Green hydrogen will help to provide a sustainable solution for the Indian industrial sector. India has fewer reserves of natural gas and green hydrogen production from renewables can make a difference in this scenario. Under the ‘Make in India’ program, India has the opportunity to start the production of electrolyzers and fuel cells which will allow capturing a large share in this market worldwide. As compared to other parts of the world, India has a low cost of electricity from the solar photovoltaic systems, this generated power in the future will be helpful to scale up green hydrogen production. Water consumption by electrolyzers will be a issue of concern. Electrolyzers consume about 9 liters of water to produce 1 kg of hydrogen. In this scenario, seawater electrolysis (being availability of large coastline in India) will be of great interest that requires further development and research work. The existing hydrogen infrastructure need to be strengthened for the larger acceptance of fuel cell vehicles. For further developments, hydrogen refueling stations are required to be created and will be play promising role.

Considering the aforementioned situation in background, the need to search for an alternate fuel, the context focuses on the opportunities offered by Green Hydrogen Economy. The concept of Green hydrogen economy brings many opportunities for India to become energy independent. For the last decade, India is constantly focusing on growing its renewable energy capacity by taking advantage of its geography. Integrating hydrogen production with these renewables can scale up the green hydrogen production in India.

India can take the advantage of its renewable energy scenario and can scale up its hydrogen production facilities. The mass production offers India an opportunity to export green hydrogen to other nations. Green Hydrogen when used with fuel cells can help India significantly reduce its petroleum imports and environmental pollution.

Renewable energy in India provides the opportunity to produce green hydrogen and to develop hydrogen infrastructure but for adoption, many challenges still need to be solved. These challenges include hydrogen production cost, storage, transportation, policies, regulations, public awareness, etc. These can be resolved with Chain of world class Indian R & D Institution and with International Cooperation . The world is slowly moving towards the adoption of a Hydrogen economy and India is also taking important initiatives. Indian organizations which include both government and public are investing in the research of hydrogen technologies. Many Ongoing research and demonstration projects are very important to develop hydrogen and fuel cell technology economically. The progress in this development will play a key role in the commercialization of the technology.

Today hydrogen is viewed as a very much promising technology for achieving net-zero emission targets as it does not emit GHG upon combustion. Its inherent chemical characteristics, multiple end-uses, and harmony with other fuel and energy carriers make it a strong contender of the clean energy transition apart from electrification, battery storage systems, carbon, capture, utilization, and storage (CCUS), bioenergy, etc.

At present, hydrogen is being primarily produced with the help of fossil fuels for use in the chemical, steel, and refinery industry. Today, it is possible to produce hydrogen with the help of renewable energy-based electricity. The 'net-zero ness' of hydrogen depends on the method of production. Steam Methane Reforming (SMR) incurs a measurable amount of emissions when used for producing hydrogen (Hydrogen produced with such process is called gray hydrogen). Green hydrogen (made from water and green electricity using electrolyzer) is considered the next big movement toward sustainable development. It has found relevance in today's energy policy narrative, given its ability to decarbonize 'hard-to-abate' industries. Hard-to-abate sectors (like the steel industry) require a significant investment of green technology than existing carbon-based technologies.

Hydrogen needs to be considered as complementary to its alternatives rather than contemplating it as an ultimate and stand-alone solution as it comes with its own constraints. The present storage and transportation technologies are expected to be mature and cost-effective by 2030. Hence, the production and near-real-time utilization of hydrogen at the same location can be promoted to safeguard investments against undesirable sunk costs.

Production of green hydrogen requires water and green electricity as input to the electrolyzer.

The availability of sufficient water streams is critical as it is a valuable and limited resource having multiple application areas. Desalination plants can be set up to process wastewater or seawater for electrolysis to avoid possible water usage conflicts. Freshwater from such desalination plants can also be provided to the local population if the plants are set up in water scarce regions. Green hydrogen as an energy sector can become a reality in India if the large availability of renewable and water resources are used optimally.

India's Efforts about the hydrogen economy


India's ambitious plans of installing 450 GW of renewable energy capacity will only fuel its drive to become the global hub of green hydrogen manufacturing.

CNBC-TV18 has reported from sources that a Rs 15,000-crore production-linked incentive (PLI) scheme was being worked on to push for electrolyser manufacturing in India. The scheme is expected to run for a period of five years, starting from FY24 with possible certain tax benefits. The ultimate aim of the government is to bring down the cost of green hydrogen to \$1 per kg and have five million metric tons per annum (MMTPA) green hydrogen capacity by 2030 in India. India's largest company Reliance Industries Limited and its Chairman Mukesh Ambani has announced that the green Energy Giga Complex will have an electrolyser factory for green hydrogen production, and a fuel cell factory. He hopes that India can bring down hydrogen costs massively in the future. RIL hopes to become a net-zero emissions company by 2035, and a Rs 75,000-crore investment in green energy is a large part of the plan.

"Green hydrogen is the best and cleanest source of energy, which can play a fundamental role in the world's decarbonisation plans. Efforts are on globally to make green hydrogen the most affordable fuel option by bringing down its cost to initially under \$2 per kg. Let me assure you all that Reliance will aggressively pursue this target and achieve it well before the turn of this decade. And India has always set and achieved even more audacious goals. Am sure that India can set an even more aggressive target of achieving under \$1 per kg within a decade. This will make India the first country globally to achieve \$1 per 1 kilogram in 1 decade – the 1-1-1 target for green hydrogen," he said.

Way forward ;

Renewable energy in India provides the opportunity to produce green hydrogen and to develop hydrogen infrastructure but for adoption, many challenges still need to be solved. These challenges include hydrogen production cost, storage, transportation, policies, regulations, public awareness, etc. The world is slowly moving towards the adoption of a Hydrogen economy and India is also taking important initiatives. Indian organizations which include both government and public are investing in the research of hydrogen technologies. Many Ongoing research and



demonstration projects are very important to develop hydrogen and fuel cell technology economically. The progress in this development will play a key role in the commercialization of the technology. Well-developed fuel cell technology and locally produced green hydrogen will be key players to decarbonize the Indian transport sector by replacing the current petroleum-based vehicle engines.

As Indian businesses invest in research and development across the entire green hydrogen value chain, the lack of a homegrown research workforce will become a bottleneck. Addressing this challenge will not only require serious investment in universities to scale up their research and research training programs but also strong incentives for collaboration between academia, corporate labs and public research institutions. When universities are an integral part of the national research enterprise, they produce human capital aligned with national economic needs which has a long-term multiplier effect in sustaining innovation.

As the Indian Industries to make Key strides toward decarbonization , the entire industrial sector needs to be brought under the decarbonization umbrella with strong political backing, steady investment and receptiveness for innovation and change ,industrial decarbonization will transform India to a sustainable future.

No country needs green hydrogen more than India – to reduce life-threatening air pollution in its cities, to escape the debilitating financial burden of energy imports, and to decarbonize its rapidly growing economy. No country has a more urgent need to fast-track the green hydrogen economy and lead the way than India.