# Opportunities for Green Hydrogen in India

**Dr. Joydev Manna,**

Senior Scientist

Hydrogen Energy Division, National Institute of Solar Energy

(An autonomous institute under Ministry of New & Renewable Energy, Govt. of India)

Hydrogen is mostly used in industrial applications, and it has been noted that petroleum refining, and ammonia production are the principal industrial consumers of hydrogen. The global demand for hydrogen during 2018 was around 73.9 million tonnes, of which 51.6% and 42.6% were consumed by petroleum refineries and ammonia synthesis units, respectively. Other industries using hydrogen include industries involved in production of methanol, vegetable oils, steel, flat glass, semiconductors, and synthetic fuel; cooling of generators in thermal power plants; and food processing etc.

Total hydrogen demand in India is estimated to be around 2.6 million tonnes per annum in petroleum refineries and 3 million tonnes in fertilizer industries This hydrogen is mostly produced by reforming fossil fuels such as natural gas, naphtha, or coal. Recently, Govt. of India has announced to launch a National Hydrogen Mission (NHM) for green hydrogen production during 2021. It is expected to boost demand for green hydrogen for industrial applications. This mission is likely to play a catalytic role for development of activities related to production and utilization of green hydrogen in the country.

Generally, there are three sources of hydrogen: fossil fuel, water, and biomass. The conventional methods such as Reforming, Gasification or Partial Oxidation of fossil fuels emit huge amount $CO_2$ during hydrogen production. The generated hydrogen by these methods is known as “grey hydrogen”. If the generated $CO_2$ after these processes is captured and sequestrated using advanced technologies, then the produced hydrogen would be known as “blue hydrogen”. The term “green hydrogen” is used when hydrogen is generated using completely 100% renewable energy or biomass.

Hydrogen generated from biomass is considered as “green hydrogen” as released $CO_2$ during hydrogen generation process almost gets compensated by the amount of absorbed $CO_2$ while biomass grows. In case of using renewable energy, hydrogen is mostly generated from water by splitting its molecules using three major sources of energy *i.e.*, light (photon), heat, and electricity. If the source of these energies is renewable in nature (such as solar, wind, etc.), then hydrogen so produced is called as “green hydrogen”. Among the various developed process for water splitting, electrolysis is the most developed,

effective and can be used for large scale hydrogen production. Electrolysers are used in electrolysis process to split water molecule into hydrogen and oxygen using electricity.

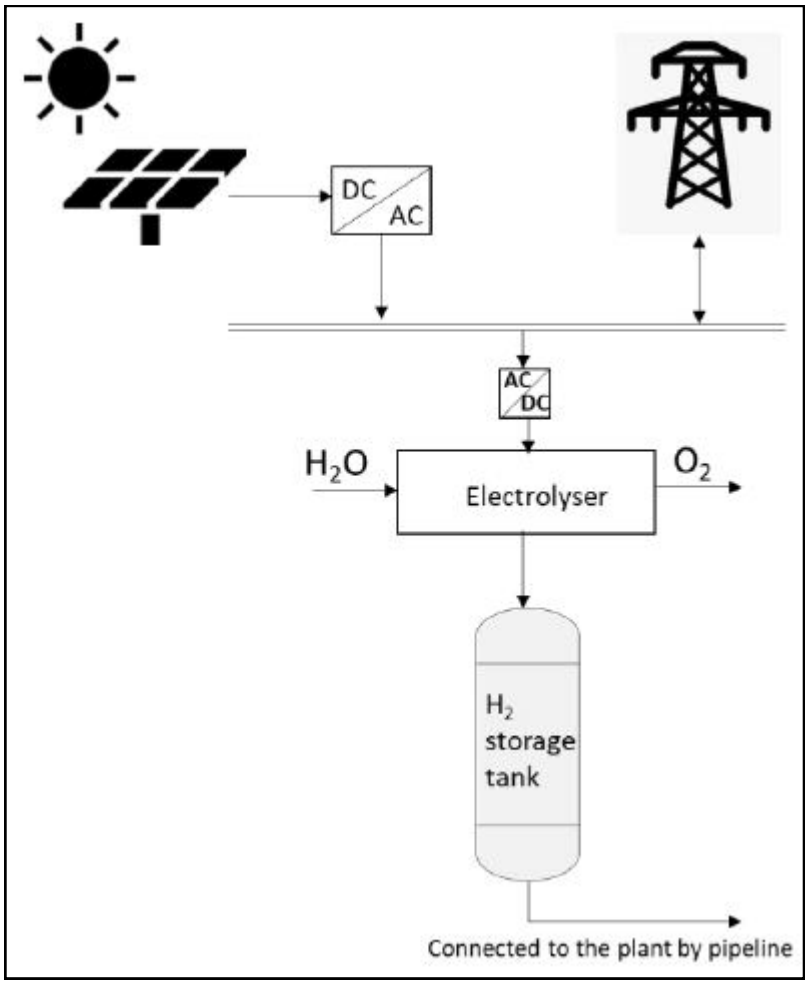


**Fig. Schematic of a typical solar PV powered green hydrogen plant**

India is rich in renewable energy resources with estimated power generation potential of about 1100 GW, of which contributions from solar, wind (at 100 m height), and biomass energies being 750 GW, 302 GW and 50 GW, respectively. About 93 GW of power generation capacity based on renewable energy has already been established in the country with contributions from wind and solar being 39.247 GW and 40.085 GW, respectively, as on 31.03.2021. Both solar and wind resources are expected to play significant role in making a switch to green hydrogen in India.

As far as hydrogen demand in petroleum refinery and ammonia synthesis is concerned, we have estimated that about 90 MW and105 MW electrolyser have to be installed for the petroleum refineries and ammonia synthesis units, respectively, in India. It has also been estimated that about 1.7 GWp of solar PV plant will be needed for fully powering the green hydrogen production systems of these industries.