Innovative solar technologies for

Green Hydrogen Production

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With an increasing number of countries setting strong net-zero targets, there is a global push for the gradual discontinuation of fossil-fuel usage and the large-scale adoption of renewable energy (RE). In this context, green hydrogen is seen as the fuel of the future, with various governments and energy companies betting on it.

Green hydrogen production has three vital requisites: electricity (generated from RE sources) to run electrolyzers; high-purity fresh or desalinated water; and electrolyzers to split the water molecules into hydrogen and oxygen. While scaling up the production of green hydrogen is desirable, there are challenges that primarily relate to water availability, high RE-share requirement, and the cost of electricity transmission and the associated infrastructure.

Currently, various research and development organizations across the world are working on innovative solar technologies for producing green hydrogen. These technologies can help in overcoming the challenges associated with large-scale green hydrogen production while making the process more efficient and economical.

Researchers at KU Leuven, Belgium, under the Solhyd project, have developed a solar hydrogen panel that captures moisture from the air and then uses solar energy to split the captured water molecules into hydrogen and oxygen. The panel can, as of now, produce 250 liters of hydrogen per day. The KU Leuven team has already developed multiple prototypes and is now working on bringing the product to the market.

Similarly, researchers at the University of Melbourne, Australia, have developed a direct air electrolysis (DAE) module for producing hydrogen directly from the air. The module uses hygroscopic materials to absorb water from the air and can work in areas where the relative humidity is as low as 4 percent. It can produce around 750 liters of green hydrogen per day per square meter of the electrolyzer.

The above technologies enable the production of hydrogen directly from the moisture available in the air, addressing the water availability challenges.

Another innovative solar technology that is being tried out involves the direct conversion of solar energy to produce green hydrogen, thereby doing away with the requirement for a separate electrolyzer. This direct solar-to-hydrogen conversion can avoid the costs and losses associated with electricity transmission.

Spanish firms Repsol and Enagas are jointly developing a direct solar-to-hydrogen technology demonstrator plant with a daily production capacity of 100 kgs (of green hydrogen), with plans for a commercial launch by 2030. The firm's technology—which works on photo-electrocatalysis—offers a one-step process where the received solar radiation directly generates electrical charges to split the water molecules into hydrogen and oxygen.

Meanwhile, American firm SunHydrogen has developed a nano-particle-based hydrogen panel prototype that can produce green hydrogen directly from sunlight, using any water source. The firm is now gauging the panel's growth potential and commercial viability.

These nascent solar technologies, when scaled up, can transform green hydrogen production.

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Given their potential for effecting significant energy and operational cost savings in the large-scale production of green hydrogen, solar technology innovations need to be explored and encouraged in India. Such technologies can also optimize water usage, making green hydrogen production possible in water-scarce locations. Moreover, they can accelerate India's pace for achieving the ambitious National Green Hydrogen Mission targets. However, to conduct research for innovation, as well as to gauge the adaptability potential of solar technologies under research globally, a strong collaboration between India's research institutes, industry partners, and foreign universities will be crucial.