

The Hydrogen Journey

Transforming India's Energy Landscape

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THE clean energy transition is rapidly moving forward in India, particularly with hydrogen, which is emerging as a success story in national and scientific news. New hydrogen vehicles are officially on the road, with significant advances in laboratory research on hydrogen production, storage and transportation. The country has initiated a critical transition to achieve a sustainable carbon-neutral energy economy. Hydrogen fuel is widely regarded as the fuel of the future, having the distinct advantage of producing only water when used as a fuel. As water is emitted on its combustion, hydrogen is one of the cleanest energy sources. At present, 96% of hydrogen is produced from fossil fuels which is grey/blue hydrogen, while only 4% is produced through a green process, primarily via the electrolysis of water. As there is a huge amount of underutilised resources available in India in the form of biomass and wastewater, the trends are shifting to green and bio-based hydrogen. Biohydrogen is biologically produced from organic wastes using microbial fermentation or biomass gasification and related processes, and is emerging as a key role in India's strategy for decarbonising energy in transport and sustainable waste management. Numerous scientific institutions in India are now dedicated to advancing microbial processes for hydrogen generation from biowastes,

including agricultural residues, kitchen waste, and waste from the Agricultural Produce Market Committee (APMC).

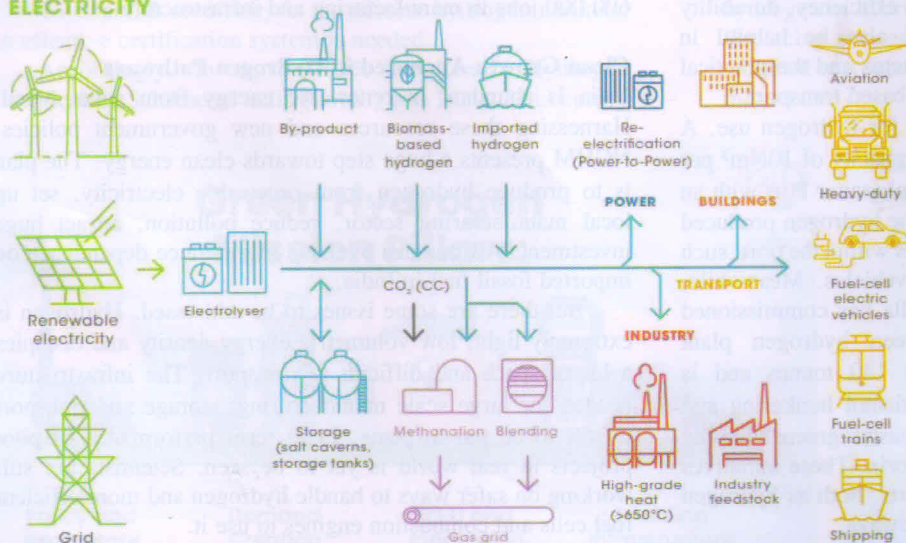
According to the Ministry of New and Renewable Energy (MNRE) report, India produces around 228 million MT of agricultural residue and other biogenic waste annually. If a country converts its organic waste (agricultural residue) to hydrogen via dark fermentation, it has the possibility to generate over 1.01 million MT H₂/year, even with a modest 20% theoretical yield (a conservative estimate). These figures highlight India's huge untapped potential of agricultural and organic waste resources for green hydrogen production. Biohydrogen will reduce dependence on fossil fuels, its import, transform the waste management system, enhance rural income, and also strengthen the nation's position in the global clean energy transition.

Hydrogen Mobility Gains Ground

In a groundbreaking initiative, Tata Motors has launched the first trials of hydrogen-fueled heavy-duty trucks in India under the National Green Hydrogen Mission, approved by the Union Cabinet led by the Prime Minister, along with the Ministry of New and Renewable Energy (MNRE). The

fleet comprises sixteen trucks, of which several will also take part in evaluations, two of which are the Tata Prima H.55S (the Fuel Cell Electric Vehicle) and the Prima H.28 H₂-ICE (Hydrogen Internal Combustion Engine). These evaluations will be conducted on primary freight routes, including along the route from Mumbai to Pune. These trucks are expected to be able to travel anywhere from 300-500 km on a single refill of hydrogen and they will operate with only water vapour emitted. This is a significant step in reducing carbon emissions in the logistics sector in India as it accounts for higher carbon outputs than other sectors. In tandem with Tata's commercial vehicle evaluations, Hyundai Motor India

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Source: IRENA, 2018a

A systems diagram illustrating the integration of renewable power-to-hydrogen technology across various sectors like transport, industry, and buildings.