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National Green Hydrogen Mission

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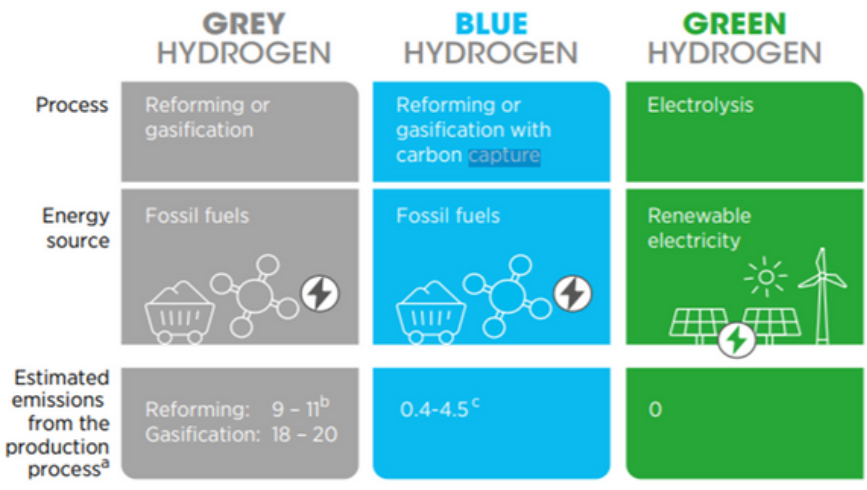
The global search for clean energy is profoundly changing the world order based on fossil fuels. According to a recently released report, hydrogen could account for up to 12% of global energy use by 2050, resulting in the rise of new energy superpowers.

The Prime Minister stated during the launch of the country's National Hydrogen Mission in 2021 that green hydrogen could help India make a "massive leap" to energy independence by 2047. Policymakers are considering legislation that would require oil refineries and fertilizer plants to use a certain amount of green hydrogen in their manufacturing processes. Green hydrogen could be a huge value-added opportunity for India as it shifts away from imported fossil fuels that currently meet the majority of the country's oil and gas demand, according to Tim Buckley, Director of Energy Finance Studies, Australasia, for the Institute for Energy Economics and Financial Analysis.

Hydrogen is the universe's lightest and also most abundant element. It is rarely found in its elemental form in nature and must be extracted from other hydrogen-containing compounds. Hydrogen is classified into three types based on the method of extraction used, namely gray, blue, and green.

Figure 2.2 Selected colour-code typology of hydrogen production



Note: a) $CO_{2\text{-eq}}$/kg = carbon dioxide equivalent per kilogramme; b) For grey hydrogen, 2 kg $CO_{2\text{-eq}}$/kg assumed for methane leakage from the steam methane reforming process. c) Emissions for blue hydrogen assume a range of 98% and 68% carbon capture rate and 0.2% and 1.5% of methane leakage.

Source: World Economic Forum

HYDROGEN: THE INDIAN CONTEXT

India's deep pledge to ambitious Climate Goals has now been broadly recognized by the international community. Our accomplishments have matched our goals. India has the world's fastest growing capacity for renewable energy. India has also emerged to be one of the most appealing destinations for renewable energy investments. As India strives to achieve energy independence by 2047 and Net Zero by 2070, we highlight the important role of Green Hydrogen. With its vast renewable sources of energy, India has the potential to produce Green Hydrogen for the rest of the globe. The mission of the National Green Hydrogen Mission is to provide a holistic action plan for constructing a Green Hydrogen ecosystem and catalyzing a systemic response to the challenges and opportunities of this emerging sector.

Increasing the use of renewable energy across all economic sectors is critical to India's Energy Transition. Green hydrogen is regarded as a promising option for facilitating this transition. Hydrogen can be used for long-term renewable energy storage, fossil fuel replacement in industry, clean transportation, and potentially for decentralized power generation, aviation, and marine transport.

Outcomes of the Mission:

By 2030, the Mission is expected to achieve the following results:

- Green hydrogen production capacity of at least 5 MMT (Million Metric Tonnes) per year, with an associated renewable energy capacity addition of approximately 125 GW in the country
- Total investment of over 8 lakhs crore
- Over 6 lakhs new jobs will be created.
- Over 1 lakh crore in cumulative reductions in fossil fuel imports
- Annual greenhouse gas emissions are reduced by nearly 50 million tonnes.

Benefits of National Green Hydrogen Mission:

- Making India the world's leading manufacturer and supplier of green hydrogen
- Development of export markets for green hydrogen and its derivative products
- Reduced reliance on imported fossil fuels and feedstock
- Building indigenous manufacturing capabilities
- Increasing industry funding and business opportunities
- Creating workforce and economic growth opportunities
- Research and development projects are being supported.

Hydrogen for Renewable Energy Integration

Hydrogen provides a means of archiving variable renewable energy in order to stabilize its output. Converting excess available energy into hydrogen and using it for transmission networks and other applications is seen as a suitable option for long-term storage that would last several hours.

What are the Challenges for the National Green Hydrogen Mission?
In Nascent Stages Globally: Green hydrogen development is still in its early stages around the world, and while India has the potential to be a major producer, it lacks the necessary infrastructure to carry out all of these intermediate steps.

Economic Sustainability: One of the most significant challenges that the industry faces in commercializing hydrogen is the economic sustainability of extracting green hydrogen.
On a per-mile basis, hydrogen must be cost-competitive with conventional fuels and technologies for transportation fuel cells.

PROGRESS TOWARDS GREEN HYDROGEN: INDIAN CONTEXT

The Prime Minister's goal is to make India an energy-independent nation by 2047, with green hydrogen serving as an active alternative fuel to petroleum/fossil-based products.

India's annual hydrogen demand is expected to be 6 million tonnes (MT) in 2020. It is predicted that by 2030, hydrogen costs will have dropped by half.

The demand for hydrogen is expected to more than fivefold by 2050, with 80 percent of the demand being green in nature.

Reliance Industries Limited (RIL), Gas Authority of India Limited (GAIL), National Thermal Power Corporation (NTPC), Indian Oil Corporation (IOC), and Larsen and Toubro (L&T) are among the prominent industrial behemoths planning to enter the green hydrogen space. RIL intends to become a net-carbon zero company by 2035 and to invest nearly INR 750 billion in renewable energy over the next three years.

Indian Oil, a government-led public sector undertaking (PSU), is at the forefront of the green hydrogen revolution. It intends to build India's first green hydrogen unit for the Mathura refinery, which will process crude oil.

National Thermal Power Corporation (NTPC) recently issued a tender to build a first-of-its-kind hydrogen refueling station in Leh that will be powered entirely by renewables via a standalone 1.25 MW solar system.

There are now two hydrogen refueling stations (one each at Indian Oil R&D Centre, Faridabad and National Institute of Solar Energy, Gurugram). India has stated its desire to become a hydrogen exporter to Japan, South Korea, and Europe.

Numerous hydrogen-powered vehicles have been developed and demonstrated as part of projects funded by the Indian government. Tata Motors Ltd. has 6 cell buses, Indian Oil Corporation Ltd. has 50 hydrogen enriched CNG (H-CNG) buses in Delhi in collaboration with the Govt. of NCT of Delhi, and 2 hydrogen fueled internal combustion engine buses (by IIT Delhi in collaboration with Mahindra & Mahindra).

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