

India: A Green Hydrogen Global Hub

Rajiv Theodore

Increasing renewable energy use across all economic spheres is central to India's Energy Transition. Green Hydrogen is considered a promising alternative for enabling this transition.

The new year began with one of the most significant announcements in clean energy--National Green Hydrogen Mission, a stellar initiative that is expected to translate into a cumulative reduction in fossil fuel imports of over Rs. 1 lakh crore and a cutback of nearly 50 MMT of annual greenhouse gas emissions by 2030.

The Union Cabinet chaired by Prime Minister Shri Narendra Modi approved the Mission with an initial outlay of Rs. 19,744 crore to make India a global hub for manufacturing of this clean energy source. The mission seeks to promote development of green hydrogen production capacity of at least 5 MMT (Million Metric Tonnes) per annum with an associated renewable energy capacity addition of about 125 GW in the country by 2030. On the long run, it envisages an investment of over Rs. 8 lakh crore and creation of over 6 lakh jobs by 2030.

The Ministry of New and Renewable Energy (MNRE) will formulate the scheme guidelines for implementation. The Mission will also help India export high-value green products making it one of the first major economies to industrialise without the need to 'carbonise'. India's distinct advantage in terms of low-cost renewable electricity, complemented by rapidly falling electrolyser prices, can enable green hydrogen to be not just economical compared to fossil-fuel based hydrogen but also compared to the green hydrogen being produced around the globe.

Some Salient Features of the Mission

- Creation of export opportunities for green hydrogen and its derivatives; decarbonisation of industrial, mobility and energy sectors; reduction in dependence on imported fossil fuels and feedstock; development



of indigenous manufacturing capabilities; creation of employment opportunities; and development of cutting-edge technologies.

- Facilitate demand creation, production, utilisation and export of green hydrogen. Under the Strategic Interventions for Green Hydrogen Transition Programme (SIGHT), two distinct financial incentive mechanisms -- targeting domestic manufacturing of electrolysers and production of green hydrogen -- will be provided under the Mission.
- Support pilot projects in emerging end-use sectors and production pathways. Regions capable of supporting large scale production and/or utilisation of hydrogen will be identified and developed as Green Hydrogen Hubs.
- Public-private partnership framework for R&D

The author is a Delhi based journalist. Views expressed are personal. Email: rajivtheodore@gmail.com

(Strategic Hydrogen Innovation Partnership - SHIP) will be facilitated under the Mission. R&D projects will be goal-oriented, time bound, and suitably scaled up to develop globally competitive technologies. A coordinated skill development programme will also be undertaken.

- All concerned ministries, departments, agencies and institutions of the central and state governments will undertake focussed and coordinated steps to ensure successful achievement of the Mission objectives.
- Rs. 19,744 crore outlay include Rs. 17,490 crore for the Strategic Interventions for Green Hydrogen Transition Programme (SIGHT), Rs. 1,466 crore for pilot projects, Rs. 400 crore for Research and Development, and Rs. 388 crore towards other mission components.
- The manufacturers of Green Hydrogen / Ammonia and the renewable energy plant shall be given connectivity to the grid on priority basis to avoid any procedural delays.
- To ensure ease of doing business a single portal for carrying out all the activities including statutory clearances in a time bound manner will be set up by MNRE.
- Manufacturers of Green Hydrogen / Green Ammonia shall be allowed to set up bunkers near Ports for storage of Green Ammonia for export / use by shipping. The land for the storage for this purpose shall be provided by the respective Port Authorities at applicable charges.

The Story So far

Prime Minister Shri Narendra Modi aims to transform India into an energy independent nation by 2047 where green hydrogen will play an active role as an alternate fuel to petroleum/ fossil-based products. In 2020, India's hydrogen demand stood at 6 million tonnes (MT) per year and is estimated that by 2030, the hydrogen costs will be down by 50 per cent. The demand for hydrogen is expected to see a five-fold jump to 28 MT by 2050 where 80 per cent of the demand is expected to be green in nature. Top industry leaders such as 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) plan to foray into the green hydrogen space.

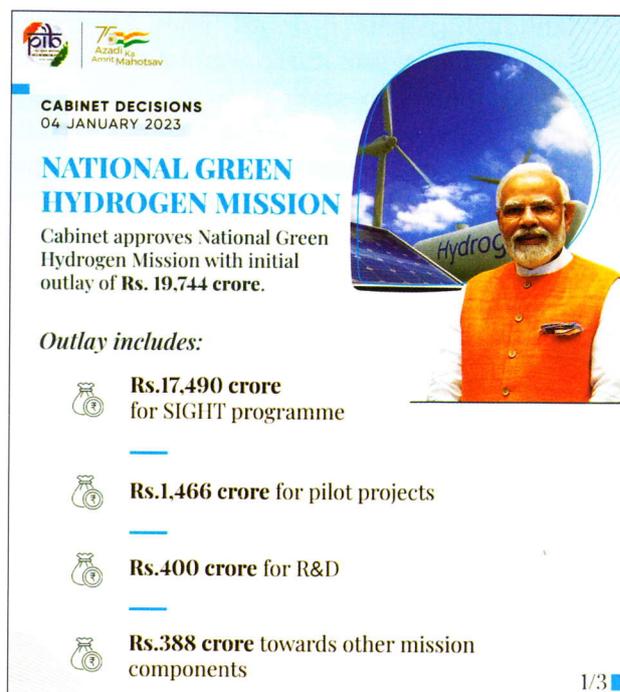
- RIL plans to become a net-carbon zero firm by 2035 and invest nearly INR 750 billion over the next three years in RE.
- Indian Oil is at the forefront of the green hydrogen revolution. It is planning to setup India's first green hydrogen unit for the Mathura refinery, which will be used to process crude oil.
- NTPC has recently set up a tender to establish a first-of-its-kind hydrogen refuelling station to be powered entirely by renewables in Leh through a stand-alone 1.25 MW solar system.
- Two hydrogen refuelling stations have been established (one each at Indian Oil R&D Centre, Faridabad and National Institute of Solar Energy, Gurugram).
- India has declared its ambition to become an exporter of hydrogen to Japan, South Korea, and Europe.
- Various hydrogen powered vehicles have been developed and demonstrated under projects supported by Government of India. These include 6 Cell buses by Tata Motors Ltd., 50 hydrogen enriched CNG (H-CNG) buses in Delhi by Indian Oil Corporation Ltd. in collaboration with Govt. of NCT of Delhi, 2 hydrogen fueled Internal Combustion Engine buses (by IIT Delhi in collaboration with Mahindra & Mahindra).

Increasing renewable energy use across all economic spheres is central to India's Energy Transition. Green Hydrogen is considered a promising alternative for enabling this transition. Hydrogen is utilised for long-duration storage of renewable energy, replacement of fossil fuels in industry, clean transportation, and potentially also for decentralised power generation, aviation, and marine transport. In terms of integrating renewable energy, Hydrogen provides a means for storage of variable renewable energy for stabilising its output. It plays a unique role in long duration energy storages, converting excess available energy into

hydrogen and utilisation in grid support.

It may be noted that several countries which would eventually adopt green hydrogen technologies are not ideally situated to satisfy their projected hydrogen demand by producing it locally and they will eventually become dependent on imported green hydrogen. This potential opportunity in hydrogen trade for India which currently relies heavily on importing fuel to meet its demand. India has vast potential to divert its renewable power capacities to produce green hydrogen for the export market, making India a global green hydrogen hub. Pursuing Green Hydrogen aggressively, India has a distinct advantage in low-cost renewable-energy generation and world-class clean-power execution capabilities makes green hydrogen the most competitive form of hydrogen in the medium run. This enables India to be potentially one of the most competitive producers of green hydrogen in the world. Since 75 per cent of the cost of green hydrogen is dependent on renewable energy, India should target to further bring down the cost of solar power to Rs. 1 per Kw/h through lower cost of financing. Energy security is another reason to pursue green hydrogen as it will enable the emergence of a domestically produced energy carrier that can reduce the dependence on fossil fuel imports of \$ 160 bn per year. In addition, with 500 GW renewables expected to come on line by 2030, green hydrogen could act as a solution to extract value out of excess renewable power while a conducive policy measures is expected to create a green hydrogen ecosystem. India should tap the export markets since there is a huge potential in the markets of EU, Japan and South Korea. India should also encourage industrial Research and Development in electrolyzers and other green hydrogen components as Indian companies cannot be dependent on foreign technology suppliers.

Industrial applications such as refining and non-urea fertilisers have to be mandated to go 100 percent green hydrogen by 2030 to ensure economies of scale for this nascent industry to flourish. With these measures, the price of green hydrogen should fall from \$ 4 per kg to \$ 1 per kg by 2030. With proper policy support, industry



CABINET DECISIONS
04 JANUARY 2023

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Cabinet approves National Green Hydrogen Mission with initial outlay of **Rs. 19,744 crore**.

Outlay includes:

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- Rs.1,466 crore** for pilot projects
- Rs.400 crore** for R&D
- Rs.388 crore** towards other mission components

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action, market generation and increased investor interest, India can position itself as a low-cost, zero-carbon green hydrogen manufacturing hub of the world. Hydrogen, as an energy carrier, is crucial for achieving decarbonisation of hard-to-abate sectors. Many sectors such as iron ore and steel, fertilisers, refining, methanol and maritime shipping emit major amounts of CO₂, and carbon free hydrogen will play a critical role in enabling deep decarbonisation.

The government is expected to allocate around Rs. 60 billion each for its production-linked incentive schemes for electrolyzers and green hydrogen from the Rs. 200 billion green hydrogen mission. “We will have a PLI for electrolyzers, and a PLI for manufacturing green hydrogen,” New and Renewable Energy minister R.K. Singh had said in October. “But the PLI for manufacturing green hydrogen will only be required for the initial capacities, maybe four to five million tonnes. After that, green hydrogen will stand on its own feet.” The Ministry of New and Renewable Energy is said to have moved a cabinet note detailing green hydrogen consumption obligations, subsidies, and standards. These would be major enabling provisions to develop the domestic green hydrogen industry and its adoption in India by bringing down market prices.

Although green hydrogen is now considered as a viable way to cut carbon emissions, major challenges remain in scaling up the technology and making it cost-effective. It is also not certain the demand will grow proportionately, and the fuel may not become the first choice in transport and industry. Changes do not happen overnight. Hydrogen cannot simply replace existing fuels, a gradual shift is the only way forward that will require changes in not only the infrastructure but also in terms of safety, consumer behavior, and skill development of millions of people currently working with fossil fuels. Electrolyser manufacturing is emerging in India, although at an initial phase, the ingredients to be a manufacturing champion with its access to skilled and cost-competitive labour, and deep experience in power electronics is evident. India needs to invest in R&D, and material supply chain, and increase local demand for green hydrogen. The use of hydrogen requires a major shift in the existing energy landscape and replacing existing infrastructure which has an available period of use, will not only become unfeasible financially, but also involve massive wastage of resources.

There is a need to consider developing new infrastructure rather than dismantling existing framework. Producing hydrogen requires diversion of excess renewable capacity since most of the energy produced is used up in meeting the constant energy demands. Hence, there is a need to produce more surplus energy. There is a possibility that India could face geo-political resistance presented by the oil producing nations. The thought of a commodity replacing oil will not be readily accepted even as disruptions in the oil and gas supply chains will be catastrophic to India's economy.

Private Sector and Green Hydrogen Initiatives

The future of hydrogen in India can also be seen from the interest in hydrogen by companies like Reliance Industries, Tata Group, Adani Group, Jindal, and more importantly, Indian Oil and NTPC. Pilot projects in hydrogen production, distribution, storage, and application have been already announced by these companies, and they are making massive investments in this sector to ensure they continue to have an edge in the

energy business. Government policy in India is also extremely supportive of new investments in the hydrogen ecosystem and recently Indian enterprise can satisfy their renewable purchase obligations (RPOs) by purchasing green hydrogen. In India, the production cost of green hydrogen is around Rs. 500 per kg. The government expects to reduce the cost of manufacturing green hydrogen by 40-50 per cent through its policy initiatives.

The recent developments could see India emerging as a key base for hydrogen electrolyser production with 8GW capacity by 2025. The investor interest is so high that western companies are also entering into India's green hydrogen market through joint ventures. India's Greenko is building a 2GW factory in partnership with Belgium's John Cockerill and Nevada-based Ohmium. Reliance is building electrolyser factories in partnership with Denmark's Stiesdal, and L&T with Norway's Hydrogen Pro. Gautam Adani, has committed financing to a one GW factory as the first step in its recently announced plan to produce three million tonnes of hydrogen by 2030, which would require 16GW of electrolyser capacity. There is little doubt that Indian companies are pushing hard to develop a local industry by tapping into the financial heft of local conglomerates and technical know-how from the Western world.

Marquee names in India Inc as well as renewable energy companies have already bet big bucks in green hydrogen manufacturing and most major industrial houses are doing so as part of their decarbonisation drive. Reliance Industries Limited (RIL), which plans to utilise the green hydrogen it produces for inhouse consumption initially, not retail sales. The company is looking to utilise global technology to reduce manufacturing costs. In October 2021, RIL joined hands with Danish company Stiesdal A/S to develop and manufacture hydrogen electrolysers. On almost similar lines, state-owned oil marketing company Indian Oil Corporation aims to replace at least a tenth of its current fossil-fuel-based hydrogen at its refineries with carbon-free green hydrogen. In fact, most companies plan to consider captive use first.

The Hinduja group, which launched its renewable energy business in 2016, is looking to

expand in green hydrogen manufacturing for this purpose. The group wants to leverage its presence in the supply chain across sectors. Transport would be one major sector. Commercial vehicle maker Ashok Leyland, part of the Hinduja group, plans to include multiple fuels in its portfolio. Adani Enterprises Limited, which has launched a separate petrochemical company and a new energy company with the core focus on green fuels. Adani Petrochemicals plans to offer a variety of green fuels and utilise its supply chains and RE units for production and transport. The company has a four-pronged plan to manufacture Green Hydrogen, Green Methanol, Green Ammonia and Green Fertiliser.

Gurugram-based ACME Group has said it is planning to invest about Rs 1.5 trillion in green hydrogen and ammonia for its upcoming units in Tamil Nadu, Karnataka and Oman. The RE company is also looking for foreign equity partners and off-take tie-ups for these projects. Another renewable energy major ReNew Power has recently signed a preliminary agreement with the Egyptian government to invest \$ 8 billion to produce green

hydrogen in the country. Despite this bullishness prices will be competitive only with an assured market. The global green hydrogen market was valued at \$ 1.83 billion in 2021 is expected to hit over \$ 89.18 billion by 2030, expanding at a compound annual growth rate of 54 per cent from 2021 to 2030.

The Asia-Pacific region is the fastest growing area in the green hydrogen market. India has set a target of an annual production capacity of 25 million tonnes by 2047. The number could well be revised upwards as the technology evolves and the demand outlook improves. India's current output of green hydrogen is low and comes from a just handful of pilot projects. By the end of this decade, the country wants to produce 5 million tonnes of green hydrogen. By 2030, India also plans to add 175 GW capacity of green-hydrogen-based energy. India today is in the process of finalising a roadmap for becoming green hydrogen economy which would require Rs. 15 trillion and another Rs. 15 trillion to meet middle-term goal by 2030. So, in all, these initiatives would require an investment of Rs. 30 trillion by 2030.

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Expected Mission Outcome:

- Development of green hydrogen production capacity of at least **5 MMT (Million Metric Tonne) per annum**
- Renewable energy capacity addition of about **125 GW in country**
- Over **Rs. Eight lakh crore** in total investments
- Creation of over **Six lakh jobs**
- Over **Rs. One lakh crore** cumulative reduction in fossil fuel imports
- Abatement of nearly **50 MMT of annual greenhouse gas emissions**

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Benefits

- Creation of export opportunities for Green Hydrogen and its derivatives
- Decarbonization of industrial, mobility and energy sectors
- Reduction in dependence on imported fossil fuels and feedstock
- Development of indigenous manufacturing capabilities
- Creation of employment opportunities
- Development of cutting-edge technologies

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