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GUEST EDITORIAL

Green hydrogen for a sustainable and 'aatmanirbhar' India

Human civilization is facing an existential crisis due to climate change. Power generation, transport and major production industries account for the bulk of greenhouse gas (GHG) emissions. Decarbonizing the power generation sector is a work in progress and will continue with the increased penetration of renewable energy (RE) in the electric grid. In the road transport sector, the plan is to move the fleet away from internal combustion engines to electric vehicles. However, at present, there are limited avenues to decarbonize aeroplanes or ships. Further, although the industrial sector emits more GHGs than the transport sector, it has historically not received adequate attention for decarbonization. Compared to the road transport sector, emission-intensive industries like steel, fertilizer, cement and refinery cannot be directly electrified. The transport and industrial sectors, which cannot be directly electrified and decarbonized, are jointly referred to as 'hard-to-abate' sectors of the economy. However, India has an ambitious plan for them – green hydrogen, the fuel of the future.

Green hydrogen is obtained by splitting water into hydrogen and oxygen in an electrolyser using RE. This provides an opportunity to reduce carbon emissions by using it as a fuel (transport including aviation and shipping applications), feedstock (fertilizer plants), reducing agent (steel industry), chemical agent (refineries) and for producing hydrocarbon fuels from carbon dioxide (cement industry) through the carbon capture and utilization pathway. Till August 2022, at least 38 countries and the European Union (EU) were developing or have announced national-level policies and strategies for hydrogen.

At COP26 in 2021, India showed true climate leadership. It proposed a fivefold strategy called the 'Panchamrit' that included a net zero target by 2070. Subsequently, the country significantly revised its nationally determined contributions. In addition to meeting its climate goals, India also aspires to be energy-independent by 2047. To achieve these targets, there is a greater emphasis on alternative fuels through schemes such as Sustainable Alternative Towards Affordable Transportation and the National Bioenergy Programme. Green hydrogen offers India an opportunity to meet its climate goals and achieve energy independence.

India has been proactive on green hydrogen. In his 2021 Independence Day speech, the Prime Minister announced India's plan to launch the National Hydrogen Mission. Subsequently, the Ministry of Power, Government of India (GoI) notified the ammonia/hydrogen policy in February 2022. The Cabinet cleared the National Green Hydrogen Mission in January 2023 with an initial outlay of Rs 19,744 crore. It supports the development and commercialization of indigenous green hydrogen technologies to reduce dependence on imported fossil fuels and carbon emissions.

Today, green hydrogen is more expensive than grey hydrogen, which is derived from fossil fuels. This implies, that in the early phase, industries will be unwilling to voluntarily consume green hydrogen because it might affect their profitability and market competitiveness. To address this challenge, the Government recently passed the Energy Conservation (Amendment) Act in both the houses of Parliament. The Act has provisions through which it can mandate industries to consume green hydrogen. India consumes about 5.6 million tonnes per annum (MTPA) of hydrogen, mostly across the refinery and fertilizer sectors. Therefore, in the initial phase, it is expected that the mission will create a guaranteed demand for green hydrogen by enforcing blending norms in these industrial units. As the green hydrogen ecosystem in the country scales up, there are plans to support its growth in sectors such as transport, energy storage and blending with natural gas pipelines.

Green hydrogen can be a game changer for India. First, the green hydrogen/ammonia policy notified targets to produce 5 MTPA of green hydrogen by 2030. It is estimated that this will decrease India's liquefied natural gas imports by 68%, save USD 5.5 billion in import bills and reduce GHG emissions by 1.6% (or 50 million tonnes), based on 2020–21 consumption.

Second, green hydrogen also offers significant opportunities in the industrial and transport sectors. India can produce about 2.1 MTPA of green hydrogen to offset its imports of methanol, ammonia and fertilizers. The steel industry can potentially consume 2.7 MTPA of green hydrogen. If the penetration of fuel cell electric vehicles (FCEVs) were to reach the levels in developed countries today, then an additional green hydrogen demand of 0.1 MTPA could be created within India. Further, a 15% blend (on volume basis) of green hydrogen in natural gas pipelines can create a green hydrogen demand of 0.65 million tonnes. Thus, the total green hydrogen demand in the industrial and transport sectors can go up to 5.55 MTPA. This will be over and above the 5.6 MTPA already consumed in fertilizer and petrochemical plants, and refineries.

Third, green hydrogen gives India a massive export opportunity. The world consumed about 94 MTPA of hydrogen

in 2021. Although developed countries are large energy-consumers, few have access to sufficient RE to produce green hydrogen. These countries plan to import fuel and derivatives such as green ammonia. For instance, the EU has set a target of importing 10 MTPA of green hydrogen by 2030. Japan is also actively seeking contracts for importing green ammonia. This opens new opportunities for India to turn from an energy importer to an energy exporter. The trade in green technologies and industrial commodities is also expected to increase significantly in the future. In a 2050 global net-zero scenario, the demand for electrolysers is expected to be 850 GW by 2030, opening an export market worth USD 425 billion (assuming electrolyser cost of USD 500 per kW). Green steel, although 50–70% more expensive than conventional steel, is an emerging market in developed countries. India is the second largest steel producer in the world, has one of the lowest RE tariffs and can aim to export green steel.

Fourth, green hydrogen-derived fuels can also create significant refuelling opportunities for flights and ships originating from or transiting through India. The International Air Transport Association has committed to net zero emission by 2050. The enforcement of the Carbon Offsetting and Reduction Scheme for International Aviation and the Carbon Border Adjustment Mechanism could also provide an opportunity for India to blend sustainable aviation fuel in flights headed to the EU and other countries. The International Maritime Organisation aims to cut GHG emissions by 50% before 2050, and India could provide green ammonia refuelling for some ships.

While green hydrogen offers multiple opportunities to India, it also presents significant challenges. They are:

(1) Unprecedented scale of deployment of RE and electrolyser: India needs at least 40 GW electrolysers and 100 GW RE to meet 5 MTPA green hydrogen production target. Today, the electrolyser manufacturing capacity in India stands at only 0.5 GW per year. The National Solar Mission, instrumental in commercializing solar power, was launched in 2010 (13 years ago), and reached an installed capacity of only 62 GW by December 2022.

(2) Economics of green hydrogen: Today, green hydrogen at USD 3–3.5 per kg is roughly two times the cost of grey hydrogen available at USD 1.5 per kg. A significant reduction in the cost of RE and technological improvements in electrolysers is required to reduce this cost. Here, academic institutions and research laboratories have a pivotal role to play.

(3) Disparity in open-access charges: Open access provides industries the flexibility to wheel RE from its generation to consumption point through the electric grid by paying a premium. This premium, termed as open-access charges, is the payment that a consumer makes, over and above the generation tariff. There is significant disparity and uncertainty in open-access charges across states that affect the cost of producing green hydrogen and consequently, the competitiveness of the industries in certain geographies. The ability of the power evacuation infrastructure to wheel 250–270 terawatt hours (18% of total generation) of renewable electricity for producing 5 MTPA of green hydrogen also needs to be thoroughly assessed.

(4) Finance requirement: Producing 5 MTPA of green hydrogen by 2030 needs an investment of USD 100 billion, according to a study by the Council on Energy, Environment and Water, New Delhi. Further, unlocking green hydrogen opportunities in steel, blending in natural gas pipelines, and offsetting imports of fertilizer and methanol would all need an investment of another USD 110 billion. Deploying 24,000 FCEVs will need an additional investment of USD 10 billion across the value chain. Can financial institutions support this rapid deployment of green technology?

What should India do to scale-up green hydrogen demand? First, the country should focus on developing safety standards across the green hydrogen value chain and ensure compatibility with global practices. The safety standards should be integrated with a single-window clearance (with appropriate backend linkages to state and Central Government portals) for all green hydrogen projects.

Second, learn from the hard lessons of the National Solar Mission and focus on the indigenization of the green hydrogen value chain right from the start. The production-linked incentive should be extended to electrolyser manufacturing to ensure 100% indigenization. Further, the Government should secure supplies of raw materials needed.

Third, India should unlock innovative financing mechanisms like foreign currency-denominated loans to reduce the cost of finance and become competitive in global markets on clean fuels. This will help overcome the disadvantage of the high financing cost of green hydrogen projects.

Fourth, the country should leverage multilateralism and platforms like G20 to develop a rules-based architecture to govern the green hydrogen ecosystem globally and mitigate technology and finance risks, reduce supply disruptions, and ensure that the fuel is equitably accessible to all countries.

Fifth, India should invest in targeted joint research and development (R&D) projects in Government laboratories and academic institutions that cater to industry needs. It should also push for joint R&D with other countries.

The vision for energy independence and a pledge for net zero have been made. The National Green Hydrogen Mission will get the ball rolling. It is now important that India seizes the initiative and grabs opportunities opened after COP 27. Hydrogen, after all, is the new oil.

Disclaimer: The opinions expressed here are of the author.

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