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Fuelling a truly green transition
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India should take the lead in establishing a global alliance for promoting hydrogen, whose role as a clean fuel is dependent upon how it is produced

In January this year, the Indian government released its Green Hydrogen Mission (GHM), which "aims to provide a comprehensive action plan for establishing a green hydrogen ecosystem and catalysing a systemic response to the opportunities and challenges in this sunrise sector". The Mission is seen as a critical component of India's declared commitment to achieve net-zero carbon emissions by 2070.

The GHM is not only important for meeting India's climate change goals, but, in parallel, also projected to advance India's energy security by providing a plentiful and clean source of energy. Given the scale at which this mission will have to be undertaken, the GHM sees this as an opportunity to make India a global hub for the production, usage and export of green hydrogen and its derivatives. This will contribute to the stated goal of creating a self-reliant, or Atmanirbhar Bharat.

Since the GHM is such a significant part of India's energy security and climate change strategy, it may be useful to examine its various dimensions, its viability and whether the assumptions underlying the mission are credible.

Hydrogen is the most abundant gas in the universe. It is, however, not available as a free element that can be easily extracted and used. It can be extracted by processes that currently involve the use of fossil fuels. One such process is called steam reforming, which splits natural gas into hydrogen and carbon dioxide (CO_2). Since CO_2 is a by-product of this process, the hydrogen produced is known as "grey hydrogen". However, if the CO_2 thus produced can be captured through carbon capture, use and storage (CCUS) technologies, then it may be termed as "blue hydrogen." CCUS remains a very costly technology despite several years of R&D. It has proved viable only where there are depleted oil and gas wells available for large scale storage of CO_2 emissions.

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Another process used is electrolysis, which splits water atoms into hydrogen and oxygen. If the energy used for electrolysis comes from clean and renewable sources of energy, then it may be described as "green hydrogen." For India's GHM, therefore, we must assume that there will be a massive increase in renewable energy capacity and generation to make hydrogen a viable and clean fuel in India's energy transition.

Burning hydrogen produces only water hence it is a clean fuel. It is also more efficient. The amount of energy produced per unit of hydrogen is estimated to be three times the equivalent weight of petrol and seven times that of coal. Hydrogen is a flexible fuel as it can be stored easily when not in use. It may also be liquefied and transported through pipes or in tanks via roads, rail and ships. It may be converted to fuel cells to generate electricity or for heating. It may be used in long distance transportation. It is already used in a wide range of industrial processes. But the expansion of hydrogen use as a clean, green fuel is dependent upon how it is produced. Only "green hydrogen" will fit the bill as a truly clean fuel.

The International Renewable Energy Agency (IRENA) has pointed out that currently 95 per cent of the hydrogen produced is through fossil fuels. The projections of the International Energy Agency indicate that by 2030 about 50 per cent of low carbon (not zero carbon) hydrogen will come from electrolysis and the rest from steam reformation of natural gas but using CCUS. Hydrogen is viable as a fuel at $100 per tonne. The current costs are three to six times higher. With an increase in scale, the cost may come down by 30 per cent by 2030. There is still a long way to go before hydrogen emerges as a mainstream energy source and an even longer path for it to be substantially "green." Can India go faster than the expected global trajectory?

The GHM envisages the development of green hydrogen capacity of at least 5 million metric tonnes (mmt) per annum by 2030 with an associated renewable energy capacity addition of 125MW. This will involve a total investment of ₹8 trillion. The production and deployment of high-performance electrolysers are planned along with the use of decentralised renewable power, such as from roof-top solar, micro-hydel plants and biomass to provide clean and cheap power for electrolysis. There is mention of the use of waste water in these processes. However, the ambitious intent has not yet been translated into specific plans with numbers. The GHM requires very detailed and rigorous modelling to establish its economic viability.

There is no doubt that hydrogen could emerge as a source of clean and abundant energy, but it is not a magic bullet, nor is it a viable alternative as of yet. But the technological parameters are constantly advancing and with scale costs will come down. We have seen this with solar power. India's development trajectory is tied to its capacity to ramp up the availability of energy at affordable cost. The GHM is timely because it seeks to explore a promising source of plentiful, clean and potentially cheap source of energy. To the extent that scale will be a factor in making hydrogen an economically viable energy source, India has a comparative advantage. Its renewable energy capacity has been growing rapidly and this will be important in ensuring that the hydrogen produced is truly green.

There are important technological advances taking place in the promotion of hydrogen as a fuel source in several advanced countries. Japan has a comparatively advanced hydrogen programme. As part of the GHM, India should seek closer collaboration with countries that are leaders in the field. The International Solar Alliance was a far-sighted initiative of the government to promote solar energy in India and be part of a global collaborative effort. It would be in India's interest to take the lead in establishing an International Hydrogen Alliance enabling the pooling of technological and financial resources for the promotion of the hydrogen economy globally. The forthcoming G20 summit would be a good occasion to announce such an initiative.

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