Green Hydrogen Energy in India:

Can we give the ‘Green’ signal yet?

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Issue Brief

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ISSUE BRIEF

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ABSTRACT

The Union Minister for Road Transport and Highways for India recently arrived at the Parliament House in a 'hydrogen-fuelled' car. This occurred in the backdrop of the Ministry of Power [MoP] announcing the first phase of the 'Green Hydrogen Policy' on 17 February 2022. The policy aims to cut down greenhouse emissions and promote clean energy, among other things, by positioning Green Hydrogen as a potential fuel for industrial and domestic purposes. The policy aims to curb the dependence on fossil fuels and potentially place India as a global leader in fuel production. In this context, the issue brief discusses some fundamental issues on India's path to becoming a global pioneer of Green Hydrogen. These issues include the challenges of cost-effectiveness, lack of infrastructure capacity and domestic demand, insufficiency of existing supply chains, and a suitable investment map for the effective implementation of the Green Hydrogen Policy. Further, this brief discusses the various nuances of the policy in terms of the position of stakeholders, economic implications, and transition from an economy highly dependent on coal and natural gas.

Keywords: Hydrogen, Electrolysis, Energy, Sustainable Development, Fossil Fuels

CONTEXT: SHIFT TO 'CLEANER AND GREENER' ENERGY

The 26th Conference of Parties [COP26] in Glasgow reaffirmed the goal of the Paris Agreement to limit the increase in temperature below 1.5°C. More importantly, COP26 brought a sharp focus on decarbonisation[1] (United Nations, n.d.). A significant highlight was countries deciding to 'phase down' the use of fossil fuels and "phase out… inefficient" fuel subsidies (United Nations, n.d.).

These conscious efforts to reverse the effects of climate change are imperative due to the duality of the climate crisis–growing population on the one hand and depleting reserves of non-renewable fuels on the other. An interplay of the two has necessitated a search for alternatives. Considerable investments in climate finance and research have led to the emergence of green fuels or biofuels[2]. One of the biggest contenders in this 'cleaner energy race' is Green Hydrogen.

Green Hydrogen has featured in nearly all recent climate-related conventions and conferences, including the COP26 (Chugh & Taibi, 2021) and the Green Hydrogen Catapult[3] (Climate Champions, n.d.). Green Hydrogen is hailed as a measure to decarbonise industries, especially the hard-to-abate[4] industries, for two primary reasons. Firstly, the hydrogen in use is currently derived using fossil fuels. It is called 'Grey Hydrogen' or 'Brown Hydrogen' depending on the raw material used in the output–coal or natural gas. Secondly, these hydrogen-based fuels also release carbon dioxide, which contradicts the motive of producing clean energy (Sadik-Zada, 2021; Ajanovic et al., 2022). On the other hand, Green Hydrogen is extracted through electrolysis[5] and produces no carbon residue.

[1] Decarbonisation means reducing the levels of Carbon-Dioxide in the atmosphere. Contextually, it means moving to an economic system that is more sustainable, where conscious efforts in reducing carbon dioxide levels.

[2] Biofuels refer to a source of energy that has a relatively lower carbon footprint and can be extracted using renewable methods (Othman et al., 2017).

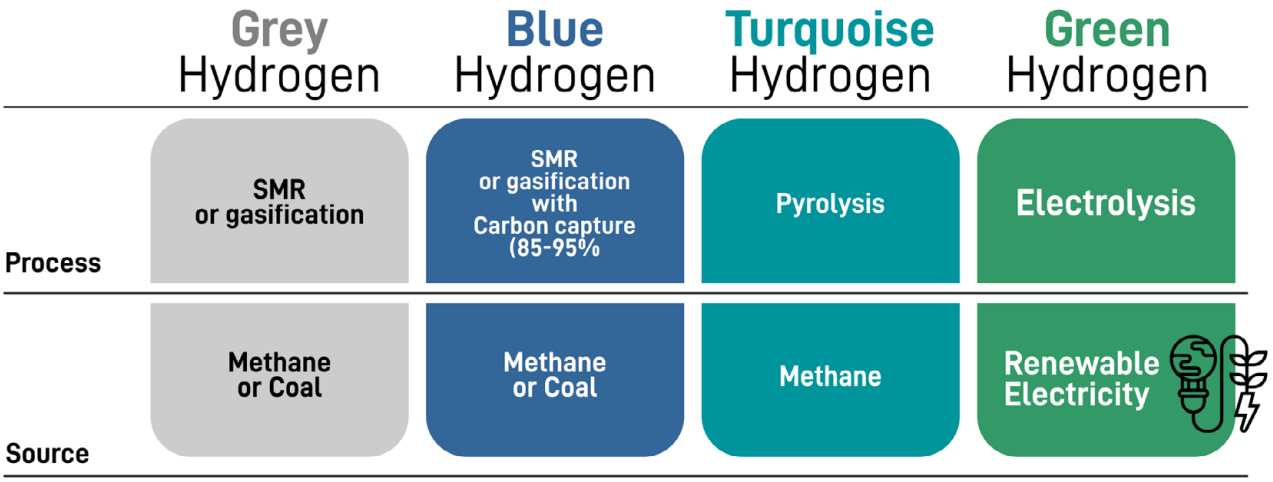
[3] The Green Hydrogen Catapult is a coalition between the UN and some of the world's largest energy companies that is aimed at bringing down the cost of Green Hydrogen.

[4] The hard-to-abate sectors are those that are hard to decarbonise, given the long-term costs of operations, the technology, and the infrastructure involved. Heavy industries such as steel, cement and coal, and transportation and aviation are examples of hard-to-abate sectors. (Gross, 2022)

[5] Electrolysis is a process in which an electric current is passed through water to split it into hydrogen and oxygen.

RENEWABLE ENERGY -----> ELECTROLYSIS -----> HYDROGEN + OXYGEN

Figure 1: Obtaining Green Hydrogen



Note: SMR = steam methane reforming
*Turquoise hydrogen is an emerging decarbonisation option

Source: International Renewable Energy Agency (2020)

In this context, the issue brief first analyses India's emerging opportunity to establish itself as a global leader in producing Green Hydrogen within the Green Hydrogen policy framework. Further, it analyses the implementation challenges facing the same.

India currently uses about 6 million tonnes of hydrogen in energy production (Bhatti, 2021). However, most of the hydrogen being used is Grey or Blue Hydrogen, derived from a non-renewable source like methane or coal. The Green Hydrogen Policy released by the Ministry of Power in February 2022 aims to shift this consumption to Green Hydrogen. The policy aims to produce 5 million tonnes of Green Hydrogen per annum by 2030 (Varadhan, 2022). The Green Hydrogen policy was envisaged under the National Hydrogen Energy Mission in the Union Budget 2021-22. The policy echoes the Prime Minister's resolve to make India a "global hub for Green Hydrogen production and export" (Sirur, 2021).

GREEN HYDROGEN POLICY: CONTOURS AND CHALLENGES

There are two aspects to the adoption of Green Hydrogen. The first aspect is India's looming energy crisis and high dependence on imported coal and natural gas. The use of coal provides 55% of the country's total energy needs (Ministry of Coal, n.d.). The second aspect is the imminent climate crisis pushing countries to look for more sustainable alternatives. In light of climate change, India has made several environmental commitments on the global stage, outlined by its Nationally Determined Contributions [NDC]. Moreover, the switch to Green Hydrogen aligns with India's commitment to achieving net-zero carbon emissions by 2070 and reaching a renewable energy capacity of 500 GW by 2030.

I. Proposed Incentives

The emphasis on increased Green Hydrogen use rests on the argument that the adoption of Green Hydrogen-based energy will help contribute to the overall adoption of renewables. The policy proposes monetary and infrastructural incentives for producers and power companies to push domestic production capacity and demand. These incentives include waiving transmission charges and setting up manufacturing centres. Green Hydrogen producers are exempt from paying Inter-State Transmission Charges [ISTC] for 25 years on the renewable energy projects commissioned until 30th June 2025 (Ahluwalia, 2022). This waiver of ISTC helps achieve two things. First, the cost of renewable energy bought in bulk will be substantially reduced, which will create competition in the domestic market. Consequently, more firms, especially regional and small firms, can enter the market.

Additionally, the Power Ministry will prioritise connectivity to grids for plants set up to produce Green Hydrogen. However, it remains to be seen whether the grids at the state level would be willing to provide open access to producers who operate in another state (Kumar et al., 2022). Considering the applicability of Green Hydrogen in the shipping industry, the policy also envisages setting up plants near ports.

Further, the policy mentions a single-clearance system on a centralised portal for all the clearances required to set up a Green Hydrogen plant (Singh, 2022). It also allows the producers to bank their Green Hydrogen energy with the power distribution companies. The policy also suggests providing concessions to power companies that buy Green Hydrogen. The procurement rates will only include the procurement and wheeling charges and will be accounted for under the state's Renewable Purchase Obligation. Put together, these incentives may significantly reduce the prices of Green Hydrogen from current levels by 2030 (Perinchery, 2022).

II. Hits and Misses

Despite all of its merits and incentives, the policy leaves several gaps unaddressed. For instance, the policy does not specify the type and technology used for electrolysis to extract Green Hydrogen. Currently, there are three major types of electrolytic technologies. The one in use at present—Alkaline Water Electrolysis—is the most mature method and has about 70% market share globally. However, the process needs to be run continuously to avoid damage (Ajanovic et al., 2022). The other two are more suited to urban settings. S.S.V Ramakumar, the Director at Indian Oil and a key person involved in drafting the policy, remarked that "the kind of electrolyser and infrastructural capacity required to produce Green Hydrogen is presently not available in our country" (Press Trust of India, 2022b). Thus, government reviews of the technical aspect of the process remain to be seen.

Although India has a power-trading platform, it lacks a robust and functional renewable energy market to aid renewable energy trade throughout the Indian grid. Thus, the second challenge would be the creation of domestic demand. The policy intends to incentivise the producers by waiving ISTC charges, land and machinery concessions, and priority in grid connectivity. However, policymakers are mute on creating demand in the domestic sector, especially in contrast to the predominant use of coal and oil. India has the third-largest coal reserves and hard-to-abate industries that are highly capital–intensive use mainly coal. These industries possess long-use technology with 15-20 years of strategy already in place. For example, the steel industry is entirely dependent on coal and cooking oil while also being one of the most significant carbon-emitting industries. Thus, policymakers must consider outlining an alternative system of mandating at least partial use of Green Hydrogen.

Furthermore, hydrogen is a highly combustible gas. The existing infrastructure and pipelines are only suited for natural gas transfer to homes and vehicles. If Green Hydrogen is needed to reach homes, the government must develop adequate transportation infrastructure to ensure hydrogen supply for domestic consumption. Since 2020, some pilot projects have been run in Delhi to test the limited use of hydrogen in transportation. The inter-city travel buses use a special fuel known as Hythane, an 18% hydrogen and CNG blend. These projects can be extended to other major cities to gauge the performance and feasibility of using Hydrogen in the transportation sector (Kelly & Zhou, 2022). Further, the International Council on Clean Transportation expects a price decrease in Green Hydrogen. Reduction in transportation costs and electrolysing to about Rs 340/kg due to growing demand to shift from non-renewable to renewable energy can trigger said price decrease.

Despite all the merits, the high cost of production and capital involved is a significant hurdle in the wide-scale adoption of Green Hydrogen. Green Hydrogen costs around USD 5-6 per kg at current production capacity and price levels, which is costlier than fossil fuels and about three times higher than hydrogen produced in less sustainable ways (Bhatti, 2021). Incidentally, following a similar pattern, the high costs of producing solar power a decade ago resulted in opportunity loss for India (Dasgupta & Dasgupta, 2022). Over the last decade, the cost of producing photovoltaics has reduced by 89% (Roser, 2020). Prices have dropped drastically due to increased economies of scale and supply chains becoming more competitive as more renewable technology is deployed (Armstrong, 2021). This phenomenon leads to a positive loop, as more deployment occurs due to falling costs. The amount of solar capacity deployed has doubled over the past decade, and the installation price has declined by 34% (Jaeger, 2021). India has achieved some self-sufficiency in solar-power component manufacturing. To ensure energy security and decarbonisation, the government should consider specific strategies to boost domestic demand for Green Hydrogen energy and energy storage systems.

Another major challenge is the lack of policy support at the state level. The nature of the policy is such that it mandates inter-state cooperation and cannot be implemented in isolation. There is a need for a localised, robust framework on the part of states, given that the renewable energy capacity varies from one state to another. In the ten renewable-rich states—Tamil Nadu, Karnataka, Gujarat, Rajasthan, Andhra Pradesh, Maharashtra, Madhya Pradesh, Telangana, Punjab, and Kerala—the share of solar and wind energy is much greater than the national average of 8.2% (Das, 2021; NITI Aayog, n.d.). Concentrated renewable capacity leads to concerns for the renewable-rich states, such as exporting immense amounts of power to other states, displacing local coal power plants, etc. Further, it may lead to regional disparity, as experienced during the Green Revolution, where the income levels increased in states that were abundant in resources and capital. Similarly, the concentration of renewable energy in certain states would lead to more investment, increasing a few states' incomes and production levels.

Thus, setting up state-wise targets based on an analysis of current capacity levels and more localised plans for Green Hydrogen production and distribution, such as setting up micro-grids in remote areas, should be considered.

CONCLUSION

The Green Hydrogen Policy is not the end but a means to achieve a two-fold objective–reducing India's carbon footprint and establishing the country as a Green Hydrogen Hub. However, considering the current price levels of Green Hydrogen production and existing technology, this seems a far-fetched idea. The adoption of Green Hydrogen requires overcoming some implementation challenges. The transition from coal to renewable energy, of which Green Hydrogen is a part, is not easy. Moreover, the policy is silent on many aspects, such as how it aims to increase domestic demand, a suitable investment map, and research and development required for electrolyser technology.

At the recently held Raisina Dialogue, the CEO of the NITI Aayog, Mr. Amitabh Kant, remarked how India could take the lead in producing Green Hydrogen cost-effectively given the favourable climatic conditions (Press Trust of India, 2022c). In the long term, the Green Hydrogen policy also aims to set up a Global Hydrogen Hub in India. However, it lacks a clear execution plan. It is unclear whether India wishes to import electrolysis technology to fulfil its green Hydrogen targets or establish itself as a technology pioneer in electrolysers. However, given the rapidly growing calls for transitioning to cleaner fuels, India should take up the lead in manufacturing electrolysers (Kant, 2022). Establishing itself as a leader in manufacturing will help India become a technology-maker and establish domestic infrastructure. Countries like China, Japan, and some EU nations have already emerged as producers in this field. However, India has an advantage due to its large domestic market and lower labour costs and can thus tap into the market. Secondly, huge investments are needed to research, develop, and innovate the existing technology to reduce production costs. The mobilisation of funds, research aspects and setting up of critical infrastructure requires greater tandem between the private-public sectors (Press Trust of India, 2022a). Recently, ReNew Power, L&T, and Indian Oil Corporation announced a joint venture to solve the issue of significant risk investments and ensure greater economies of scale.

The waiver of the ISTC charges and prioritising grid connectivity would require greater cooperation between the centre and the state. Additionally, the policy needs to create demand among industries and individual customers to ensure price sustainability. It also needs to ramp up existing energy pipeline structures to ensure that the energy produced is not lost in transmission. Research and development will require enormous investments for innovation and infrastructure viability. Perhaps, at this point, there is a need to set up a Green Hydrogen Commission consisting of stakeholders such as experts from this field, energy and oil companies, entrepreneurs, and climate organisations to understand the nuances of producing Green Hydrogen in India.

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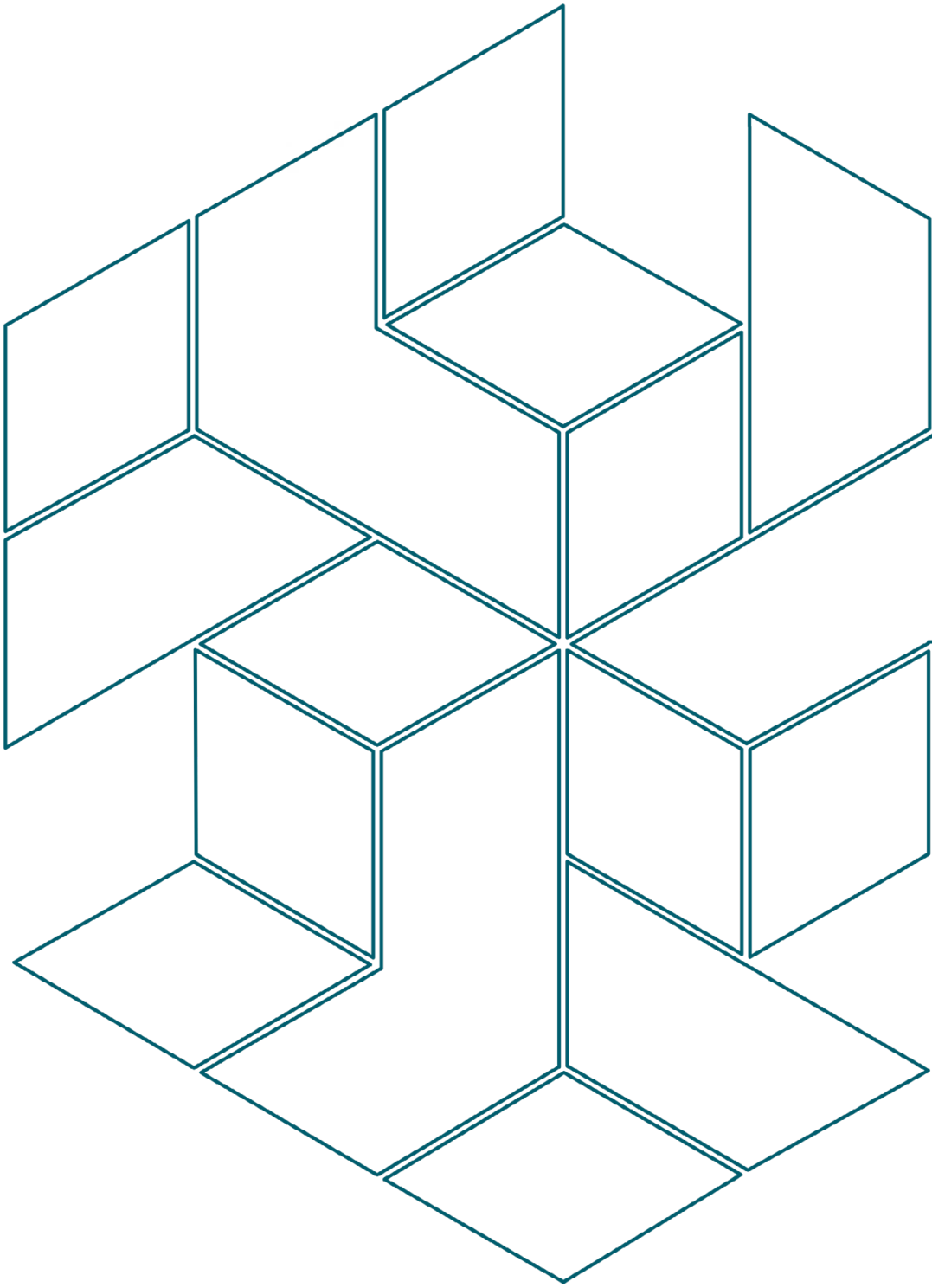

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