

Landscape for Green Hydrogen in India

INTRODUCTION

In the backdrop of India's ambitions to achieve its net zero emissions target by 2070, India has been following a mix of strategies, which include clean energy transition and energy use efficiency methods. One such strategy is the push towards Green Hydrogen ("GH₂") and its derivatives, like Green Ammonia ("GNH₃"), for which policies have been rolled out by the central and state governments. GH₂ is commonly understood as hydrogen produced through electrolysis, a process of splitting water into hydrogen and oxygen molecules, using electricity obtained from renewable energy sources.¹ GH₂ can also be produced through gasification of biomass. Similarly, GNH₃ production involves extraction of nitrogen from the air using renewable energy sources. The resultant products are clean and emission-free fuels with numerous use-cases and immense decarbonization potential, aligning with India's net zero goals.

As the world actively moves towards net zero emissions and continues to decarbonize, adoption of alternative energy sources is expected to rapidly reduce reliance on fossil fuels. This naturally paves the way for an international trade market for clean fuels and their derivatives. With relatively low-cost renewable energy, a skilled workforce, abundant land for renewable energy expansion and favorable policies, India has the potential to become an export hub for GH₂ and its derivatives – in addition to their usage in the domestic energy grid.

¹ The Ministry of New and Renewable Energy has defined Green Hydrogen as... "Hydrogen produced using renewable energy, including but not limited to, production through electrolysis or conversion of biomass. Renewable energy also includes such electricity generated from renewable sources which is stored in an energy storage system or banked with the grid in accordance with applicable regulations. For Green Hydrogen produced through electrolysis: non-biogenic greenhouse gas emissions arising from water treatment, electrolysis, gas purification and drying and compression of hydrogen shall not be greater than 2 kg CO₂ eq/kg H₂, taken as an average over last 12-month period. For Green Hydrogen produced through conversion of biomass: non-biogenic greenhouse gas emissions arising from biomass processing, heat / steam generation, conversion of biomass to hydrogen, gas purification and drying and compression of hydrogen shall not be greater than 2 kg CO₂ eq/kg H₂, taken as an average over last 12-month period.", Office Memorandum, Green Hydrogen Standard for India, dated August 18, 2023, accessible [here](#).

This note discusses the GH₂ landscape in India and sets out an overview of regulatory and policy initiatives as well as certain key considerations, primarily from the perspective of the investment climate in this sector.

REGULATION OF GH₂ AND POLICY INITIATIVES

India's Green Hydrogen Policy was launched in 2022 by the Ministry of Power containing 13 policy initiatives. Amongst these, some key suggested measures included land allotment in renewable energy parks for manufacturing GH₂ / GNH₃, thereby reducing transmission losses and costs, waiver of inter-state transmission charges for a fixed tenure, inclusion of GH₂ as part of Renewable Purchase Obligation (“RPO”) and proposals for specialized manufacturing zones. Keeping in line with these policy initiatives, a detailed and comprehensive National Green Hydrogen Mission (“NGHM”) was launched in January 2023 by the Ministry of New and Renewable Energy (“MNRE”) with an objective of providing financial stimulus and direction to accelerate the GH₂ industry in India.

National Green Hydrogen Mission

The overarching objective of the NGHM is to make India a global hub for production, usage and export of GH₂ and its derivatives. By 2030, India is looking to add a capacity of ~125GW to the country's energy infrastructure, keeping in line with the larger goal of targeting 500GW of installed non-fossil fuel based energy. The NGHM highlights that currently, annual domestic consumption of hydrogen is estimated at 5 MMT, of which majority is grey hydrogen, sourced from fossil fuels, and used largely for industrial purposes, such as petroleum refining, treatment and production of metals and production of derivatives for fertilizers. India aims to substitute its grey hydrogen demand entirely with GH₂, and the NGHM has set 2030 as the target for this transition. Regarding GNH₃, reports suggest that around 70% of ammonia is used for fertilizers and it is estimated that every unit of ammonia produced today emits twice as much in greenhouse gases. By 2034-35, the NGHM aims at substituting all ammonia-based fertilizer imports with domestic GNH₃-based fertilizers.

However, with GH₂ production costing almost double that of grey hydrogen today, there is a need for wider industry participation and technological innovation to support and execute the NGHM and its policies. GH₂ and its derivatives have, thus far, remained an untapped energy source largely due to unfavorable cost economics, regulatory uncertainty, lack of standardization, supply challenges and inadequate infrastructure. The NGHM aims to solve some of these issues through incentives, including an initial outlay of INR 197.44 billion (~USD 2.35 billion) from FY 2023-24 to FY 2029-30 towards direct subsidies. Around 90% of these funds are to be allocated for two activities namely, (i) manufacturing of electrolysers (~65%); and (ii) production of GH₂ and GNH₃ (~25%), which form the Strategic Interventions for Green Hydrogen Transition (“SIGHT”) leg of the NGHM. Plans are also in place to allocate the remaining funds towards pilot projects,

research & development (R&D) and other components. Solar Energy Corporation of India (“SECI”) has been tasked as the implementing agency for the SIGHT scheme, while overall coordination and implementation of the NGHMs remain the responsibility of the MNRE.

Green Hydrogen Certification Scheme of India

Recently, the MNRE has issued the draft of the [Green Hydrogen Certification Scheme of India](#) (“GHCI”). The GHCI is aimed towards fostering confidence among domestic and international stakeholders by providing a comprehensive framework to (i) certify and regulate GH₂ production in India, and (ii) enhance transparency, accountability, and environmental integrity in the sector. The GHCI aims to formulate clear guidelines and a detailed methodology for calculating emissions during GH₂ production, a rigorous certification process guaranteeing the origin of GH₂ and establishing monitoring requirements aimed at creating a robust verification-based approach for GH₂ production. Designated agencies accredited by the Bureau of Energy Efficiency (BEE), the nodal authority for GHCI, will be responsible for certifying, monitoring and verifying GH₂ projects as well as development of a reporting and data tracking system thereby, ensuring compliance with the certification standards.

One of the key objectives of GHCI is to establish the certification procedure as a Guarantee of Origin (GO) label, containing unique identification for each ton of hydrogen produced, project details, production year and emission intensity values. To ensure integrity of the certification process, the GHCI includes provisions for compliance and auditing by the MNRE or any agency designated by it. Failure to comply with certification conditions could lead to penalties, including cancellation of certificate, and for repeated violations, disqualifications from certification. However, the draft GHCI appears to have certain shortcomings. The scheme does not explicitly require additionality for renewable energy sources, which could lead to a reshuffling of existing renewable capacity rather than driving new renewable energy development.

Other aspects of the certification include its non-transferability and non-tradability. It does not represent a mitigation outcome or provide emission reduction credits. The draft scheme is open for comments until September 27, 2024. If implemented well, GHCI could position India as a leader in GH₂ production transparency and potentially create a model for other countries. Drawing inspiration from similar initiatives in the European Union and other countries, the GHCI aims to contribute towards global efforts to standardize hydrogen production criteria which will help boost investor confidence and develop an integrated market.

KEY CONSIDERATIONS FOR INVESTORS

The Indian government aims to encourage private investments through financial and non-financial incentives. Recently, subsidies of INR 1.57 billion (~USD 18.78 million) were awarded to GH2 Solar Pvt Ltd under the Production Linked Incentive (“PLI”) scheme for setting up a 105 MW electrolyser manufacturing capacity. Apart from incentives offered by the central government, most states have passed state-level GH₂ policies to attract investments. Some of these benefits include full or partial exemption from land tax, water consumption and electricity charges, mandatory purchase of GH₂ by state entities and its derivatives as part of their RPO, grants and waivers offered for setting up R&D centers and priority processing under a single window application system. SIGHT presents investment opportunities to both domestic and foreign investors. The SECI regularly releases global tenders for setting up production facilities, electrolyser manufacturing capacity and hydrogen hubs. For investors looking to explore these potential opportunities and enter the GH₂ market, several factors play a role in their investment decisions. This section of the note attempts to address some key considerations.

Financing and incentives

The government has permitted 100% foreign direct investment through the automatic route in the GH₂ sector. A more detailed analysis on legal considerations for investing in India are available here. As far as lending is concerned, currently GH₂ is not a part of the Harmonized Master List (“HML”) issued by the Finance Ministry’s Department of Economic Affairs. The HML contains a list of infrastructure sectors and sub-sectors, lending for which is classified as an ‘infrastructure loan’. Financial institutions, banks and NBFCs lending to these sectors are governed by different regulatory requirements in relation to such loans. This enables lending to infrastructure on easier terms, including through External Commercial Borrowings (“ECBs”). Further, longer tenor funds from insurance companies and pension funds would also be available.

The HML is currently under review, and an expert committee chaired by Shri Bibek Debroy, Chairman of the Economic Advisory Council to the Prime Minister, was constituted to undertake a comprehensive assessment of the parameters defining infrastructure. Inclusion of GH₂ as an eligible sub-sector would incentivize further investments into this sector.

Currently, direct subsidies are available under the NGHMs, and understanding the financing benefits of these subsidies is crucial. Incentives are provided to successful bidders in the form of subsidies calculated at INR / unit each year, varying on the tenure. As an example, under SIGHT-I (electrolyser manufacturing) incentives are provided in terms of INR / kW corresponding to the manufacturing capacity. The base incentive is provided for five years from the date of commencement of manufacturing of electrolysers, at INR 4440 / kW in year one and INR 3700 / kW, INR 2960 / kW, INR 2200 / kW and

INR 1480 / kW in years two, three, four and five, respectively. As of date, several tender results have been uploaded on the SECI's website where detailed subsidies and yearly incentives can be viewed. To avail the incentives, beneficiaries are selected through a competitive bidding process.

Participation and eligibility

A Scheme Monitoring Committee comprising representatives from the MNRE, the SECI, and experts from other organizations periodically review implementation status of the NGHM and facilitate / recommend measures to resolve issues. As mentioned above, the SECI acts as the implementing agency and regularly issues tenders inviting interested parties to participate in a competitive bidding process. Bidders can participate through a single company, joint ventures or a consortium. Eligibility requirements are not uniform and vary, largely depending on the specific tender. As an example, under SIGHT-I, the net worth of a bidder as on last date of a financial year, as specified in tender documents, should be \geq INR 10 million (~USD 120,000) per MW of quoted manufacturing capacity. Separately, bidders must commit minimum 50% of annual sales of electrolysers towards installation of projects in India and electrolysers manufactured by such bidders must also meet certain specified technical requirements. In another tender recently released, by a government of India enterprise, for a GH₂ production unit, bidders are expected to have an average annual turnover of INR 2 billion (~USD 23.85 million) in at least one year out of the previous three financial years. As the NGHM proceeds, new tenders under SIGHT, particularly tenders for pilot and R&D projects, will be rolled out wherein participation and eligibility requirements may differ.

Demand generation

Based on various media reports, use-cases for GH₂ and large-scale demand are still being explored globally. The recent example of German rail operator EVB's [hydrogen locomotives becoming inoperable due to a disruption in hydrogen supply](#) highlights another major issue, lack of robust supply chains. Before addressing these issues, the high cost of GH₂ production may be the first hurdle to cross for generating robust demand. It has been recommended that GH₂'s price must be brought down to ~USD 2 / kg, from the current price of approximately USD 4-5 / kg, to remain competitive with its alternatives. There are several factors that need addressing, particularly concerning storage and transportation, owing to hydrogen's highly volatile nature and low volumetric energy density, that significantly affect the cost of GH₂ and make global trade challenging. It is expected that these issues will resolve over time with larger electrolyser capacities and modified storage and transportation channels.

By 2050, global demand for hydrogen is expected to more than triple and domestic demand could [grow more than fourfold](#), effectively representing almost 10% of the planet's potential demand. With a growing domestic capacity, India will look to attain self-

sufficiency while also becoming an export hub for GH₂ and its derivatives. Japan has signed an agreement to purchase green ammonia from India. News reports indicate that bilateral talks for export of GH₂ and its derivatives, and investment are potentially ongoing with Singapore and the United Kingdom. Additionally, India has entered into Memoranda of Understanding with other nations to promote R&D skill development in GH₂ industries.

As mentioned above, the draft GHCI contemplates certification. The current process outlined in the draft provides for self-declaration on emissions and other aspects of production to be verified by an Accredited Carbon Verification (“ACV”) agency. Thereafter provisional and final certificates certifying that the hydrogen produced is green under the GHCI would be issued annually.

The complex process may deter smaller players. Further, the parameters for certification would need alignment with international standards, in order to meet any requirement of countries to which the hydrogen is sought to be exported.

CONCLUSION

Currently, India is forecasting an energy revolution founded on its ambitious solar projects that have been executed over the past decade. GH₂ is poised to play a crucial role in achieving its climate commitments, including potentially achieving energy independence by 2047. However, for an affordable and accessible end-to-end GH₂ value chain, holistic and large-scale private sector participation is essential. With several large business groups and energy companies having already announced their plans, it is expected that domestically manufactured electrolyzers or locally produced GH₂ will fully be integrated in the energy grid soon. Although challenges are abound, given India’s commitment to achieve its net zero targets, with effective policy making and the burgeoning renewable energy sector in the country, GH₂ appears as an optimistic bet for the future.

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