CareEdge-ESG's insights

Green Hydrogen to Accelerate India's Transition to a Sustainable Future

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Green Hydrogen – India's Blueprint Towards a Cleaner Future

Green hydrogen is increasingly being recognized as a pivotal enabler in the global transition to a low-carbon economy—particularly for hard-to-abate sectors such as steel, refining, and heavy transport. With its vast renewable energy potential, ambitious climate commitments and targeted schemes, India is rapidly shaping its green hydrogen strategy to become a global hub for both production and export. On the occasion of World Environment Day, CareEdge-ESG explores India's evolving green hydrogen ecosystem—from policy frameworks and government incentives to industry participation and emerging technologies—while also benchmarking these developments against global trends.

In line with its goal to achieve energy independence by 2047 and net zero emissions by 2070, India initiated the National Green Hydrogen Mission (NGHM) on January 4, 2023. Grasping the concept of green hydrogen will enhance understanding of the mission's objectives and its potential impact on NGHM. Green hydrogen can be produced through –

1. Electrolysis – Water is split into hydrogen and oxygen using electricity generated from renewable sources
2. Biomass – Biomass is gasified to produce hydrogen

Electrolysis is the primary method for producing green hydrogen, with NGHM targeting a production capacity of 5 MMTPA (million metric tonnes per annum) and a 125 GW renewable energy capacity addition by 2030. Currently, India's total renewable energy capacity has crossed the 200 GW mark (PIB, India's Renewable Energy Capacity Hits 200 GW Milestone[1]), ensuring it's in line with the country's target of achieving 500 GW of installed electricity capacity from non-fossil fuel sources (i.e., Renewable Energy + Nuclear Energy) by 2030[2].

With its high energy density, green hydrogen outperforms traditional combustion engines and can power vehicles through fuel cells. Additionally, it serves as a feedstock and reductant in various hard-to-abate sectors. Its applications also extend to heating systems and electricity generation.

Global Stance on Green Hydrogen

Significant strides towards green hydrogen are also being undertaken in the global landscape, with 53 countries having well-defined strategies while 30 others are developing similar policies to transition to it (Council on Energy, Environment and Water 2024[3]). Some prominent examples are Germany's implementation of a National Hydrogen Strategy in 2020 with the target of achieving green hydrogen production of 5GW by 2030 and building capacity for an additional 5GW between 2035 and 2040 (Green Hydrogen Organisation, Germany[4]).

Australia has revamped its 2019 hydrogen strategy and released the 2024 National Hydrogen Strategy to help scale up Australia's hydrogen industry. It also has a Green Hydrogen Production Tax Incentive program and a Green

[1] https://pib.gov.in/PressNoteDetails.aspx?NoteId=153279&ModuleId=3&reg=3&lang=1
[2] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2073038
[3] https://www.ceew.in/publications/how-can-indian-policymakers-boost-investments-for-domestic-green-hydrogen-financing#:~:text=Hydrogen%20is%20becoming%20increasingly%20critical,global%20consumption%20(IEA%202021).
[4] https://gh2.org/countries/germany#:~:text=Germany%20has%20the%20most%20ambitious,be%20built%20in%202035%2D2040.

Hydrogen Headstart initiative. By 2030, these programs aim to boost Australia's domestic production capacity of green hydrogen to more than 1 MMTPA (Green Hydrogen Organisation, Australia[5]). Although an official roadmap is still under development, Saudi Arabia has already set clean hydrogen production targets of 2.9 MMTPA by 2030 and 4 MMTPA by 2035 (Center for Strategic & International Studies, Saudi Arabia[6]). It has also signed an MoU with India to co-produce green hydrogen and renewable energy and establish secure, reliable and resilient supply chains of materials used in this production.

Advantages and Challenges of Green Hydrogen

India's Ministry of New and Renewable Energy (MNRE), responsible for formulating and implementing policies, schemes and initiatives under the NGHM, has stated that the overarching objective of NGHM is to "contribute to India's aim of being Aatmanirbhar through clean energy" ensuring the following positive impacts –

- Reduction in dependency on imported fossil fuels
- Decarbonisation of various industries including hard-to-abate sectors like steel, fertilizers, refineries and energy
- Create employment opportunities
- Development of technology and indigenous manufacturing capabilities
- Inflow of investments
- Increased focus on production of renewable energy to facilitate green hydrogen production

Thus, all the benefits and initiatives discussed above make it evident that green hydrogen holds immense potential and can help India move towards a low-carbon future and play a significant role in the global clean energy transition.

Nevertheless, green hydrogen faces several challenges, particularly the high production costs. In the three largest markets—China, the US, and Europe—the expenses for producing and installing electrolysers for green hydrogen have risen by over 50% (*Bloomberg Green Energy Finance*[7]) due to inflation and delays in subsidies. Additionally, there are significant costs associated with renewable energy and the balance of plant.

Hydrogen's low density challenges storage and distribution, necessitating specialised and costly infrastructure. The existing infrastructure is limited and operates on a small scale, requiring substantial investment to enhance distribution networks for improved scalability and economies of scale. The demand for green hydrogen remains nascent and has not yet fully developed. Moreover, the materials used in electrolysers, such as platinum and iridium, could have environmental repercussions, which somewhat diminishes green hydrogen's potential as an utterly eco-friendly option alternative.

Strategies Adopted by India to boost production of Green Hydrogen

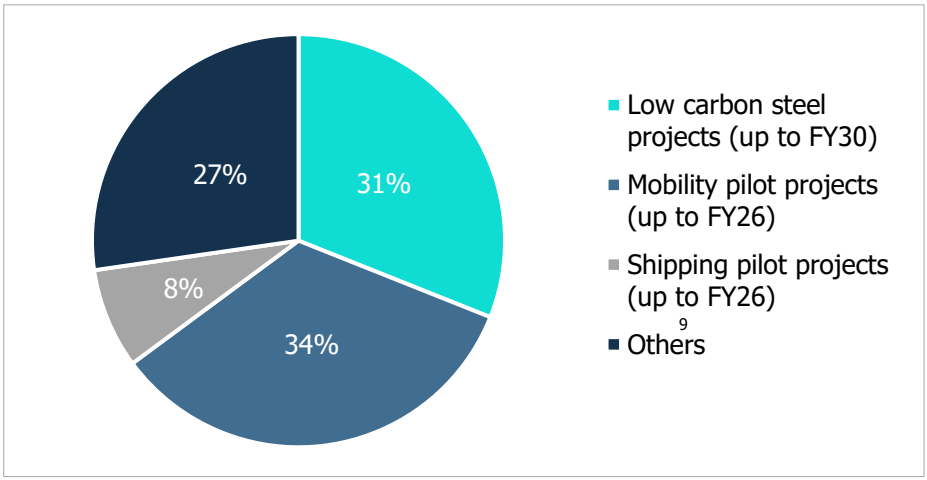
The abovementioned problems can be solved by continuous research and innovation, large-scale investment, and policy and regulatory support. To facilitate this, the initial outlay for NGHM is Rs 19,744 crore from which an outlay of Rs 17,490 crore up to 2029-30 is towards the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme (MNRE, NGHM[8]). This programme is divided into two financial incentive mechanisms, namely –

1. Incentive for manufacturing of electrolysers – As per the market and/or technology development requirement, more incentives can be added to the scheme.

[5] https://gh2.org/countries/australia
[6] https://www.csis.org/analysis/saudi-arabias-hydrogen-industrial-strategy
[7] https://www.hydrogeninsight.com/electrolysers/cost-of-electrolysers-for-green-hydrogen-production-is-rising-instead-of-falling-bnef/2-1-1607220
[8] https://mnre.gov.in/en/national-green-hydrogen-mission/

2. Incentive for production of green hydrogen – The Government has ensured quality control by setting eligibility criteria for competitive bidding (for green hydrogen procurement) to use equipment mandatorily approved by the Government of India.

Out of the total outlay, Rs 1,466 crore is set aside for pilot projects (MNRE, NGHM). This is distributed in the following way:–



The Mission also aims to find and establish regions to facilitate large-scale hydrogen production and utilisation. Such areas will be termed as Green Hydrogen Hubs. NGHM will support the development of the required infrastructure in these hubs. These hubs will help significantly reduce the cost of producing green hydrogen owing to economies of scale and specialised infrastructure, including storage and distribution facilities, refuelling stations, etc. With a fund of Rs 400 crore up to 2025-26, the government has planned to set at least two green hydrogen hubs and develop other such projects (NGHM, MNRE). NTPC Ltd has collaborated with the Andhra Pradesh Industrial Infrastructure Corporation (APIIC) to create an "Integrated Green Hydrogen Hub" on 1,200 acres in Visakhapatnam, Andhra Pradesh.

The Ministry of Ports, Shipping, and Waterways has selected Deendayal, Paradip, and V.O. Chidambaranar as the primary ports for establishing green hydrogen hubs. The V.O. Chidambaranar Port has earmarked 500 acres for the green hydrogen hub and agreed with NTPC Ltd to set up a green hydrogen production facility, marking India's first such hub. The location of V.O. Chidambaranar Port in Tuticorin, Tamil Nadu – one of India's leaders in wind energy production – makes it suitable for setting up a green hydrogen plant as the robust wind power infrastructure in proximity will help complement the green hydrogen production. Similarly, the Gujarat government plans to establish hubs in the state, utilising its 70 GW offshore wind energy potential.

Multiple private players have joined hands with government organisations/PSUs in undertaking projects to produce green hydrogen and allied products and manufacture electrolysers and fuel cells. Projects holding cumulative green hydrogen production capacity of 11.19 MMTPA have already been announced by various public and private players in the Indian economy, however, only 0.1% of these projects have been under construction or commissioned currently (MNRE Project Database.[10]). To meet the NGHM's target of 5 MMPTA and fulfil the MNRE's goal of supplying

[9] This amount is used for achieving other targets like decentralised energy solutions, biomass-based hydrogen production, hydrogen storage technologies, and more
[10] https://nghm.mnre.gov.in/project.php?cat=17&language=en

10% of the global green hydrogen demand (over 100 MMPTA) by 2030, companies must speed up their projects from planning to actual construction. This is necessary to meet the expected domestic demand of 2 MMPTA by 2030. All these developments and more are slated to change India's energy landscape with expectations of investment inflows over Rs 8 lakh crore and over six lakh new jobs to be created by 2030 (PIB, Energy Security in India[11]). About Rs 1 lakh crore worth of imports of fossil fuel and nearly 50 MMTPA of carbon emissions are expected to be reduced by 2030 (PIB, Green Hydrogen Mission[12]). These are significant steps in the right direction, which the Government has recognised by making appropriate provisions to support them.

Conclusion

The Union Budget 2025 has maintained the financial outlay of Rs 600 crore (source: Outcome Budget 2025-26[13]) for the NGHM, consistent with the allocation in the Union Budget 2024. The Mission has accordingly set a target of a cumulative green hydrogen production capacity of 1.03 MMTPA by 2025-26 out of which production tender/RfS of 0.41 MMTPA has already been awarded in 2024-25. It also aims to have a cumulative electrolyser manufacturing capacity of 3000 MWPA by 2025-26. Plans are under process to award 3 (cum.) pilot projects in Steel sector, 2 (cum.) in the Shipping sector and 4 (cum.) in the Mobility sector. The Government also has targets in place to allocate 4 (cum.) centres of excellence (CoE) for research & development in the field of green hydrogen.

[11] https://pib.gov.in/PressReleasePage.aspx?PRID=2098441#:~:text=With%20over%20Rs.%208%20lakh,Green%20Hydrogen%20in%20the%20world.

[12] https://pib.gov.in/PressReleasePage.aspx?PRID=1907705#:~:text=GREEN%20HYDROGEN%20MISSION%20%2D%20Expected%20to,2030%20%E2%80%93%20Union%20Power%20%26%20NRE%20Minister&text=On%204th%20January%202023,24%20to%20FY%202029%2D30.

[13] https://www.indiabudget.gov.in/doc/OutcomeBudgetE2025_2026.pdf

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