



# India's Green Hydrogen Strategy in Action

## Policy Actions, Market Insights, and Global Opportunities

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### ► Key Takeaways

- Launched in January 2023, India's National Green Hydrogen Mission aims to transform the energy sector, attracting ₹8 lakh crore (€88 billion) in investments and creating 600,000 clean energy jobs.
- India aims to reduce green hydrogen costs from €4.84-6.11/kg to €1.37/kg by 2030, through low-cost renewable energy and local electrolyzer manufacturing, positioning itself as a global leader in hydrogen exports.
- India is leveraging hydrogen diplomacy to forge strategic partnerships with Gulf nations and Europe, with the India-Middle East-Europe Economic Corridor (IMEC) optimizing hydrogen exports.
- To become a global hydrogen leader, India must bridge critical infrastructure gaps, fast-track electrolysis technology advancements, and overcome competition from heavily subsidized markets like China and the United States.

## Introduction

India is poised to remain the world's fastest-growing major economy, and this rapid growth is driving a sharp rise in energy demand. As the most populous country on the planet, India urgently needs to decarbonize its energy systems.

This policy brief is the third in a series analysing India's energy transition's financial and regulatory challenges. Previous analyses focused on financially distressed distribution companies (DISCOMs) and the substantial investments required to upgrade transmission infrastructure and expand battery storage capacity. This edition turns its focus to green hydrogen—a transformative opportunity that has the potential to redefine industrial growth and enhance energy security.

India must build a scalable hydrogen ecosystem to unlock its full potential, focusing on industrial and transportation applications while rapidly expanding domestic electrolyzer manufacturing. Lessons from India's past reliance on Chinese solar technology highlight the need for strong domestic capabilities. This time, the emphasis must be on fostering self-sufficiency to ensure long-term energy security.

Despite the opportunities, India's green hydrogen ambitions face key challenges, including land availability, water scarcity, inadequate transmission infrastructure, intermittent renewable energy supply, and limited domestic electrolyzer production. However, these hurdles underscore the need for bold, innovative solutions. By effectively implementing its hydrogen strategy, India can meet its energy and economic goals, leapfrog traditional carbon-intensive development models, and emerge as a global leader in the green economy.

## The national green hydrogen mission

Critical infrastructure gaps in India's energy sector threaten its long-term competitiveness. Despite ambitious capital commitments—€2.13 trillion under the National Infrastructure Pipeline<sup>1</sup>—India must significantly scale up investments to meet its growing energy demand.

This urgency is driven by India's twin objectives: achieving energy independence by 2047 and net-zero emissions by 2070.<sup>2</sup> The country currently imports over 40% of its primary energy needs, resulting in an annual expenditure of €83 billion.<sup>3</sup> As the world's third-largest energy consumer, India remains heavily dependent on fossil fuels, with coal (45.9%), oil (24%), and natural gas (5.1%) dominating its energy supply.<sup>4</sup> Reducing this dependence is vital for ensuring energy security and economic resilience.

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1. "National Infrastructure Pipeline", India Investment Grid, 2025, available at: <https://indiainvestmentgrid.gov.in>.

2. "National Green Hydrogen Mission", Government of India, 2023, available at: [www.india.gov.in](http://www.india.gov.in).

3. "Hydrogen Energy in India", India Brand Equity Foundation, November 2024, available at: [www.ibef.org](http://www.ibef.org).

4. "India", International Energy Agency, 2022, available at: [www.iea.org](http://www.iea.org).

As the world's third-largest producer and consumer of hydrogen, after China and the United States, India currently produces 6.5 million metric tonnes per annum (MMTPA)—primarily for use in crude oil refineries and fertilizer production.<sup>5</sup> However, most of this is grey hydrogen derived from natural gas through steam methane reforming. With hydrogen demand in India projected to rise by 2.5 to 3.5 times by 2040,<sup>6</sup> the challenge now lies in shifting this growing demand toward green hydrogen produced using renewable energy.

India holds a strategic advantage in the global clean energy transition, underpinned by some of the world's most competitive renewable energy prices and a solar potential estimated at 748 gigawatts (GW).<sup>7</sup> However, realising this potential will require overcoming significant external pressures. India's clean energy ambitions must contend with shifting global supply chains, exacerbated by rising trade tensions and geopolitical competition. China's continued dominance in green hydrogen technologies further intensifies the strategic challenge, underscoring the need for India to rapidly scale up domestic production to secure its position in the global hydrogen economy.

Recognizing these imperatives, the Government of India launched the National Green Hydrogen Mission (NGHM) on January 4, 2023. The mission aims to establish India as a global hub for green hydrogen production and exports. By 2030, the NGHM targets producing at least 5 MMT of green hydrogen per annum, with the potential to reach up to 10 MMTA with the growth of export markets.

The mission is expected to attract investments of up to ₹8 lakh crore (€88 billion) and create over 600,000 clean energy jobs. Beyond its economic benefits, the NGHM aims to cut nearly 50 MMTPA of CO<sub>2</sub> emissions and improve energy security by reducing fossil fuel imports worth ₹1 lakh crore (€11 billion) by 2030.<sup>8</sup>

## ***Boosting green hydrogen supply***

A significant hurdle to large-scale green hydrogen adoption is its cost. Currently, green hydrogen production in India is priced between €4.84 and €6.11 per kilogram (kg), about 40% higher than the cheapest G20 producer, Australia.<sup>9</sup> NGHM is expected to reduce production costs to €1.37/kg by 2030<sup>10</sup> through low-cost renewable energy,

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5. "Green Hydrogen: Enabling Measures Roadmap for Adoption in India", World Economic Forum, 2024, available at: [www3.weforum.org](https://www3.weforum.org).

6. "Hydrogen Market Report", Federation of Indian Petroleum Industry, 2023, available at: [www.fipi.org.in](https://www.fipi.org.in).

7. "Solar Energy Overview", Ministry of New and Renewable Energy, 2025, available at: <https://mnre.gov.in>.

8. "National Green Hydrogen Mission Overview", Ministry of New and Renewable Energy, 2023, available at: <https://nghm.mnre.gov.in>.

9. R. Sawhney "Decoding India's Green Hydrogen Potential", *Background Paper*, No. 20, ORF America, May 1<sup>st</sup>, 2024, available at: <https://orfamerica.org/>.

10. Green Hydrogen Generation, India, 2023, available at: <https://gh2.org>.

local electrolyzer manufacturing, and technological advancements.

A central financial pillar of this initiative is the Strategic Interventions for Green Hydrogen Transition program, with a total outlay of ₹17,490 crore (€1.92 billion). This includes ₹4,440 crore (€488 million) for domestic manufacturing of electrolyzers and ₹13,050 crore (€1.44 billion) for green hydrogen production. To further incentivize adoption, projects using renewable energy for green hydrogen and ammonia production will benefit from a 25-year waiver on Interstate Transmission System charges.<sup>11</sup>

Beyond direct financial support, the Government is establishing a business-friendly ecosystem to accelerate the green hydrogen economy. Measures such as simplified procedures, favourable taxation, and Special Economic Zone support will ease business operations. Additionally, a single-window clearance system will streamline approvals, reducing bureaucratic delays. The Ministry of Environment, Forest, and Climate Change has exempted green hydrogen and ammonia plants from mandatory environmental clearance, eliminating a significant regulatory hurdle.

### ***Demand creation, exports, and energy security***

Domestic demand is poised for a significant boost as blending quotas are set to be mandated for conventional hydrogen producers and consumers. India has also forged key agreements with the European Union (EU), Germany, Denmark, and Japan, laying the foundation for a thriving export market. Given its low production costs, India aims to capture 10% of the global green hydrogen market, with plans to export up to 10 MMTPA of hydrogen/ammonia annually.

By replacing imported fossil fuels with domestically produced green hydrogen, India could cut fossil fuel imports by ₹1 lakh crore (€11 billion) by 2030, reducing exposure to volatile global energy markets. Additionally, green hydrogen will be key in decarbonizing hard-to-abate sectors such as steel, fertilizers, refineries, chemicals (excluding pharma), and glass.

To support this growth, the Indian Government is introducing a competitive bidding framework to streamline procurement and reduce costs, enabling the industry to scale. The Ministry of New and Renewable Energy (MNRE) will develop technology-agnostic bidding guidelines, allowing electrolysis and biomass-based production to compete on equal footing. Additionally, a certification system will be established to verify that green hydrogen is produced using renewable energy sources, enhancing its credibility in international markets.

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11. "Supply Incentives under National Green Hydrogen Mission", Ministry of New and Renewable Energy, available at: <https://nghm.mnre.gov.in>.

## ***Phased approach, infrastructure, and innovation***

NGHM aims to accelerate India's transition to a green hydrogen economy through a phased approach, beginning with Phase I (2022-2026). This phase focuses on creating demand and ensuring supply by ramping domestic electrolyzer manufacturing. Green hydrogen will be introduced into refineries, fertilizers, and city gas systems to sustain demand. Additionally, pilot projects will be launched in steel production, heavy-duty mobility (transit buses and trucks), and shipping, while a regulatory framework will be developed to support sector growth. By the end of this phase, green hydrogen is expected to become a key element in India's industrial landscape.

Phase II (2026-2030) will focus on achieving cost parity between green hydrogen and fossil-based alternatives, driving its uptake in critical sectors like steel, mobility, and shipping. This phase will see the launch of commercial-scale projects and the expansion of pilot initiatives into industries such as railways and aviation. Infrastructure development will include hydrogen storage, transportation, and utilization systems, including hydrogen hubs, refuelling stations, and bulk transportation pipelines.

A multi-faceted approach will be adopted to ensure success, focusing on R&D, skill-building, and public awareness. The Strategic Hydrogen Innovation Partnership will drive innovation in production, storage, and utilization. The National Skill Development Mission will offer targeted skill programs, while outreach efforts will engage stakeholders, including students, businesses, and policymakers.

## **India's hydrogen economy: key industries, and growth opportunities**

According to NITI Aayog, India's green hydrogen market is expected to reach €7.3 billion by 2030, with the electrolyzer segment alone valued at approximately €4.6 billion.<sup>12</sup> Solar energy is emerging as the primary driver of green hydrogen production. Electrolysis using renewable electricity remains the most widely adopted method, though high costs and scalability issues pose challenges. India is also investing in biowaste-to-hydrogen technologies to diversify its approach.

The country's first green hydrogen plant, by the Gas Authority of India Limited (GAIL) in Madhya Pradesh, with a production capacity of 4.3 tonnes per day,<sup>13</sup> marks a significant milestone in demonstrating green hydrogen's commercial viability. Major players like Reliance Industries, Indian Oil Corporation (IOC), and National Thermal Power

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**India's green hydrogen market is expected to reach €7.3 billion by 2030**

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12. "India Green Hydrogen Market. U.S. Department of Commerce", International Trade Administration, 2023, available at: [www.trade.gov](https://www.trade.gov).

13. "Press Release", GAIL (India) Limited, May 24, 2024, available at: <https://gailonline.com>.



Corporation (NTPC) Limited have committed to ambitious projects, with plans to establish a combined green hydrogen production capacity of 3.5 MMTPA.<sup>14</sup>

The end-use applications are expanding as India works toward scaling up its green hydrogen infrastructure. IOC has launched the country's first hydrogen refuelling station in Faridabad, near New Delhi, and another at its Gujarat Refinery in Vadodara. These stations are designed to refuel up to 25 fuel-cell buses daily.<sup>15</sup> In March 2025, the central Government approved five pilot projects to deploy hydrogen-powered buses and trucks, supported by ₹208 crore (€2.3 million) in funding. Awarded to industry leaders such as TATA Motors and Ashok Leyland, these projects will introduce 15 hydrogen fuel cell vehicles and 22 hydrogen internal combustion engine vehicles.

In addition to mobility, green ammonia is becoming a key focus area, particularly in India's agricultural sector. Currently, India consumes 17 to 19 MMTPA of ammonia, primarily for fertilizer production,<sup>16</sup> but the reliance on grey ammonia—derived from natural gas—poses environmental challenges. As urea fertilizer prices soar, green ammonia offers a sustainable and cost-effective alternative, providing a promising solution to reduce the carbon footprint of India's fertilizer industry.

The Indian Government is accelerating the green ammonia transition by offering subsidies to offset incremental costs and fostering public-private partnerships to attract investments. A standout example of this progress is Sembcorp Industries' massive ₹36,238 crore (€4 billion) investment in Tamil Nadu, setting up a state-of-the-art green hydrogen and green ammonia manufacturing unit. This facility will produce 200,000 tonnes annually, which will be exported to Japan.<sup>17</sup> Tamil Nadu's strong commitment to renewable energy, supported by subsidies from the Central Government, provides the foundation for this transformative project. The proposed financial backing from the Government of Japan through the Ammonia/Hydrogen Contract for Difference (CfD) further strengthens this international collaboration.

The Indian Government has opened the door to 100% foreign direct investment under the automatic route, eliminating Government approval and making it easier for global investors to enter the market. On the ground, the Adani Group has partnered with French energy giant TotalEnergies to invest a staggering €46 billion over the next decade, driving the production and commercialization of green hydrogen in India. Their ambitious goal is to achieve 1 MMTPA of green hydrogen by 2030.<sup>18</sup>

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14. "India's Green Hydrogen Push Faces Challenges", Reuters, July 10, 2023, available at: [www.reuters.com](https://www.reuters.com).

15. S. Arya, "Indian Oil Corporation (IOC) to Establish Largest Green Hydrogen Plant at Panipat", *Times of India*, December 17, 2024, available at: <https://timesofindia.indiatimes.com>.

16. "Economic Feasibility of Sustainable Green Ammonia Use in Fertiliser Sector in India", Council on Energy, Environment and Water, September 13, 2024, available at: [www.ceew.in](https://www.ceew.in).

17. "Thiru MK Stalin, Hon'ble Chief Minister of Tamil Nadu, Lays Foundation Stone for Sembcorp's Green Ammonia Plant in Tuticorin", Sembcorp, August 21, 2024, available at: [www.sembcorp.com](https://www.sembcorp.com).

18. "Adani and TotalEnergies to Create the World's Largest Green Hydrogen Ecosystem", Adani Group, 2024, available at: [www.adani.com](https://www.adani.com).

## ***India's green hydrogen diplomacy***

India is rapidly emerging as a global leader in green hydrogen, leveraging “hydrogen diplomacy” to secure export markets and position its cost-competitive hydrogen at the forefront of the worldwide energy transition. At the 2023 G7 summit, India and Japan laid the foundation for a strategic green hydrogen partnership, focusing on advancing technology. Initiatives like the Australia-India Green Hydrogen Taskforce and the Quad Alliance (Australia, India, Japan, and the United States) aim to create integrated supply chains in the Indo-Pacific region.

India's commitment to green hydrogen was a central theme at the 2023 G20 Summit held in New Delhi. A landmark outcome of the summit was the adoption of the G20 High-Level Voluntary Principles on Hydrogen. These principles emphasize global collaboration in setting hydrogen certification standards, ensuring fair trade under World Trade Organization rules, and accelerating technological innovation. Additionally, they call for increased investment in hydrogen infrastructure and international knowledge-sharing.

Infrastructure is the backbone of India's green hydrogen ambitions, with new trade corridors being developed to improve connectivity with Europe. The India-Middle East-Europe Economic Corridor, announced at the G20 Summit, is set to streamline green hydrogen exports via pipelines through the UAE, Saudi Arabia, Jordan, and Israel, with various transport options for completing the journey to Europe.

### **India is forging strategic partnerships with Gulf and Mediterranean nations**

India is forging strategic partnerships with Gulf and Mediterranean nations to expand its export footprint and tap into Europe's lucrative hydrogen market. The Adani Group is spearheading efforts in Morocco, committing up to 10 GW of solar and wind power exclusively for green hydrogen

production aimed at European markets.<sup>19</sup> India has proposed to supply 10 million tonnes of green hydrogen annually, strengthening the EU-India Clean Energy and Climate Partnership.<sup>20</sup>

The European Investment Bank (EIB) has joined the India Hydrogen Alliance (IH2A) to bolster India's green hydrogen ecosystem with up to €1 billion in indicative funding for large-scale public-sector projects. The EIB is also exploring a credit facility with the Indian Government to accelerate investment in green hydrogen hubs, R&D, and pilot projects.<sup>21</sup>

19. S. Anouar, “India's Adani Group Plans to Export Green Hydrogen to Europe from Morocco”, *Morocco World News*, October 21, 2022, available at: [www.moroccoworldnews.com](http://www.moroccoworldnews.com).

20. S. Chaganti Singh, “India in Talks to Supply Green Hydrogen to EU, Singapore”, *Reuters*, July 5, 2023, available at: [www.reuters.com](http://www.reuters.com).

21. “EIB Backs Green Hydrogen Deployment in India and Joins India Hydrogen Alliance”, *European Investment Bank*, February 8, 2023, available at: [www.eib.org](http://www.eib.org).

Beyond infrastructure and finance, India is enhancing its research and regulatory framework to align with global sustainability standards. The second EU-India Trade and Technology Council meeting in February 2025 earmarked funds under Horizon Europe for hydrogen-related R&D, including waste-to-hydrogen technologies.

India closely aligns with the European Union's certification standards through the newly proposed Green Hydrogen Certification Scheme of India (GHCI). In a landmark move, the MNRE released a draft scheme defining green hydrogen as hydrogen produced via water electrolysis or biomass gasification—excluding carbon capture—if lifecycle emissions remain below 2 kg CO<sub>2</sub> per kg of hydrogen, averaged over 12 months.<sup>22</sup> This absolute emissions threshold is not only more stringent but also more transparent than the EU's relative savings-based approach under its Renewable Energy Directive, which classifies green hydrogen—as Renewable Fuels of Non-Biological Origin—if it achieves at least a 70% reduction in emissions compared to fossil fuels, translating to a lifecycle threshold of 3.38 kg CO<sub>2</sub> per kg of hydrogen.<sup>23</sup>

India's decision to adopt a higher benchmark signals more than regulatory convergence, reflecting a clear strategic ambition to lead. Supported by its increasing role in international platforms such as the International Renewable Energy Agency and the International Energy Agency, India is positioning itself as a contributor and a frontrunner in shaping the global green hydrogen landscape.

## ***Future outlook***

Green hydrogen is 2–3 times more expensive than its grey counterpart, with renewable electricity costs being the primary driver. While India benefits from some of the world's lowest renewable energy prices, challenges such as infrastructure gaps and financially strained state-run DISCOMs undermine the reliability of the power supply. Further complicating the transition are competition from heavily subsidized markets like China and the United States, along with technical challenges in electrolysis efficiency and hydrogen storage.

Despite ongoing challenges, India is steadily advancing its green hydrogen ambitions. By March 2025, the Government concluded its second subsidy auction, committing ₹22.39 billion (€223.9 million) over three years to support nine companies—including industry leaders such as L&T Energy Green Tech and Reliance Green

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22. "India Unveils Draft Green Hydrogen Certification Scheme", *Hydrogen Insight*, September 9, 2024, available at: [www.hydrogeninsight.com](http://www.hydrogeninsight.com).

23. "EU Rules for Renewable Hydrogen", European Parliamentary Research Service, 2023, available at: [www.europarl.europa.eu](http://www.europarl.europa.eu).



Hydrogen.<sup>24</sup> Pilot schemes in sectors such as shipping, steel, and mobility have also been launched to foster industry participation.

To unlock the full potential of green hydrogen, India must pursue targeted policy interventions. Bridging the cost gap with fossil-based hydrogen will require a strategic combination of carbon pricing, direct subsidies, and production-linked incentives to reduce costs and attract investment. Regulatory reforms are also crucial to streamline project approvals and ensure alignment between central and state Governments. Strengthening infrastructure—specifically grid modernization and expanded hydrogen storage—will be essential to balancing supply with growing demand. Additionally, designating hydrogen as a priority lending sector for banks and financial institutions can accelerate capital flows and de-risk early-stage projects.

A key pillar of India's green hydrogen strategy should be the development of integrated hydrogen hubs at strategic port locations along its extensive coastline. With access to seawater and a well-developed port infrastructure, India is uniquely positioned to lead in this sector. These hubs should combine the manufacturing of electrolyzers and fuel cells with industries supporting green ammonia, methanol, and sustainable aviation fuel production, along with export capabilities.

Three major ports—Deendayal (Kandla, Gujarat), Paradip (Odisha), and V.O. Chidambaranar (Tuticorin, Tamil Nadu)—have been identified for phased development as Green Hydrogen Hubs.<sup>25</sup> A standout example of this strategy in motion is the recently announced €19.7 billion green hydrogen hub in Andhra Pradesh. Led by NTPC Ltd.'s renewable energy subsidiary, this groundbreaking project is set to be completed by 2027. This landmark project, enabled by strong central-state collaboration, will integrate 20 GW of renewable energy capacity and is expected to produce 1,500 tons of green hydrogen and 7,500 tons of green derivatives daily.

Furthermore, India must leverage diplomatic and trade partnerships—especially through the EU-India free trade agreement—to boost its export competitiveness in green hydrogen and its derivatives. Aligning with international certification standards, such as the EU's renewable hydrogen rules, will be vital to ensuring market access and facilitating long-term global integration.

The National Green Hydrogen Mission is a bold policy initiative that now requires large-scale strategic investments to succeed. Today's choices will define whether India emerges as a global leader in green hydrogen or risks losing its competitive edge.

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24. "India Reveals Nine Successful Bidders for Second Green Hydrogen Subsidy Round Totaling \$259 Million", Fuel Cells Works, March 20, 2025, available at: <https://fuelcellsworks.com>.

25. "India's Green Hydrogen Revolution - An Ambitious Approach", Public Information Bureau, May 2024, available at: <https://static.pib.gov.in>.

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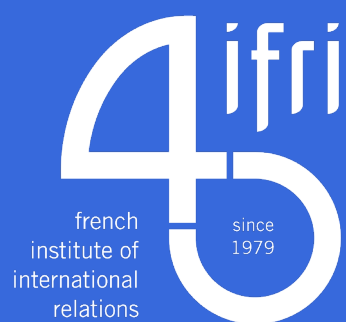
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