

Why Green Hydrogen Is Becoming an Industrial Strategy Question

October 26, 2026

Synopsis: A Molecule at a Crossroads

2-2.5x Green vs. grey H2 cost gap (India)	\$70-270/t CBAM exposure, Indian steel (EU-bound)	\$180–200B Private investment expected through 2030
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India stands at a defining energy inflection point in its post-independence history. As the world's third-largest greenhouse gas emitter and a country that still derives roughly 70% of its electricity from coal, decarbonisation is no longer optional. It is both a domestic imperative and a geopolitical necessity.

That pressure is now being reinforced through global trade policy. The European Union's Carbon Border Adjustment Mechanism (CBAM), entering its definitive phase in January 2026, will impose carbon-linked costs on imports of steel, aluminium, fertilisers, and hydrogen. While payments formally begin in 2027, the economic impact is already evident from 2026. For Indian exporters, this marks a structural shift: carbon intensity is becoming a direct driver of competitiveness. Initial estimates suggest costs for steel alone could range from \$70-190 per tonne under verified emissions reporting, rising above \$270 per tonne where the EU applies default carbon values in the absence of verified data¹.

Against this backdrop, green hydrogen is emerging as a strategically critical, though not yet cost-competitive, solution. Produced using renewable electricity, it offers a near-zero-carbon pathway for sectors where electrification is not viable, including steel, ammonia, refining, and long-haul transport. These sectors are among the most difficult to decarbonise and are increasingly exposed to emerging carbon-pricing frameworks.

This analysis evaluates the opportunity through an ESG and industrial economics lens, focusing on cost competitiveness, demand certainty, and execution risk.

What Green Hydrogen Is and Why It Matters Now

Hydrogen is an energy carrier rather than a primary energy source, and it remains overwhelmingly fossil fuel-based today. Global hydrogen demand surpassed 100 million tonnes (Mt) in 2025, driven primarily by refining and industrial applications, while low-emissions hydrogen still accounts for less than 1% of total production²; hydrogen production generated an estimated 1000 Mt of CO₂ in 2025, exceeding the combined emissions of Indonesia and France³, and excluding upstream and midstream fossil-supply emissions. Despite its growing role in industrial processes, hydrogen is therefore both a critical feedstock and a significant decarbonisation challenge.

¹ FEPS-NIPFP Carbon Border Adjustment Mechanism (CBAM) industrial impact study; supplemented by European Commission CBAM certificate default carbon asset values, as reported by Fastmarkets

² International Energy Agency (IEA), Global Hydrogen Review 2025 and 2026 editions – Tracking global demand matrices and low-emission production capacity baselines

³ Ember & Centre for Research on Energy and Clean Air (CREA) – Consolidated global emissions tracking datasets and sub-continental fossil footprint models

Green hydrogen, produced through electrolysis powered by renewable electricity, is one of the few scalable decarbonisation pathways for hard-to-abate industries such as steel, refining, fertilisers, chemicals and long-distance transport. Its relevance therefore extends beyond climate commitments; it could reshape industrial value chains and become a future source of competitive advantage.

The primary barrier remains cost. Renewable hydrogen is currently estimated to be 1.5-5x more expensive than unabated fossil-based production⁴. However, this gap is expected to narrow as renewable energy and electrolyser costs decline. For India, where renewable power costs are among the lowest globally, the debate has shifted from technological feasibility to industrial positioning. The key strategic question is no longer whether green hydrogen will play a role, but which segments will achieve cost parity first and therefore capture disproportionate value as the market matures.

~100 Mt Global hydrogen demand (2025)	~1 Mt Low emissions H₂ production (2025)	27 Mtpa Announced low-emissions capacity (2030)
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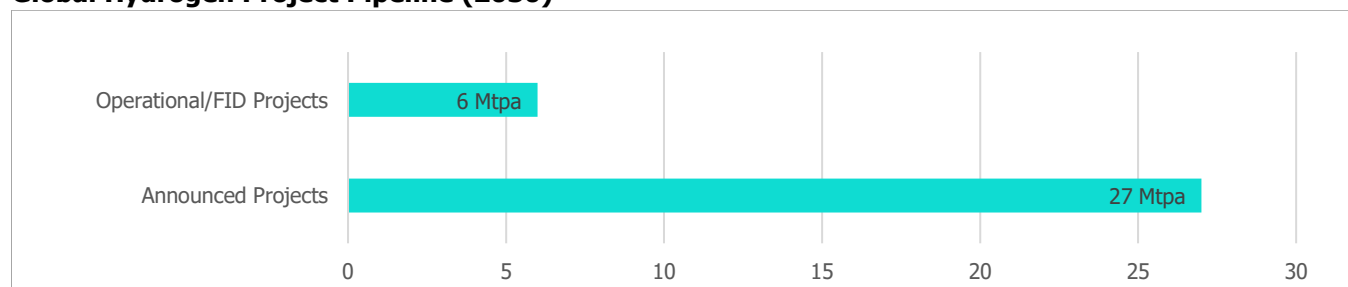
The Global Market

Despite substantial policy momentum, global hydrogen development is now characterised by a widening gap between announced capacity and executable projects, with more than 50 countries publishing national hydrogen strategies and governments committing substantial policy support to develop domestic hydrogen ecosystems. However, project execution has not kept pace with ambition.

According to the IEA's Global Hydrogen Review 2026, announced low-emissions hydrogen projects could deliver approximately 27 Mtpa of production capacity by 2030. However, operational projects, under-construction projects, or those that have reached Final Investment Decision (FID), or have a strong likelihood of commissioning by 2030, amount to only slightly above 6 Mtpa (strictly FID-committed capacity is narrower still, at 4.3 Mtpa; the 6+ Mtpa figure includes projects with strong potential to reach FID in 2026-27)⁵. The gap between announced ambition and executable capacity remains a defining characteristic of the sector.

This gap between announced capacity and commissioned production represents one of the most significant structural risks facing the sector. For India, this global execution gap presents both a risk and a strategic opportunity; a chance to leapfrog if domestic constraints are addressed early.

Global Hydrogen Project Pipeline (2030)



⁴ IEA, Global Hydrogen Review 2024 – Levelized cost frameworks for fossil vs low-carbon hydrogen generation assets

⁵ IEA, Global Hydrogen Review 2026: Production Pipeline Analysis – Documenting global execution matrices, 2030 project attrition delays, and verified operational/FID pipelines

India's Strategic Position

India has moved aggressively to position itself in the emerging hydrogen economy. In January 2023, the Government launched the National Green Hydrogen Mission (NGHM) with an outlay of Rs 19,744 crore (~US\$2.4 billion), targeting at least 5 million metric tonnes (MMT) of annual green hydrogen production by 2030, along with substantial investments, job creation, and domestic manufacturing development⁶.

The Mission is being implemented primarily through the SIGHT (Strategic Interventions for Green Hydrogen Transition) programme, which supports both electrolyser manufacturing and green hydrogen production. Multiple allocation rounds have awarded manufacturing capacity and production incentives to a growing pool of industry participants, though execution still trails ambition significantly.

India's opportunity, however, extends beyond policy support. The country combines some of the world's lowest renewable energy costs with a large existing hydrogen demand base across refining, fertilisers and chemicals, providing a potential pathway to scale production while reducing import dependence and industrial emissions. The launch of the Green Hydrogen Certification Scheme of India (GHCI) in 2025 further strengthens this position by establishing traceability and certification standards that will be critical for accessing international markets⁷. However, India's ability to capitalise on this opportunity ultimately hinges on one factor: cost.

Hard-to-abate sectors: The Industrial Demand Case

Unlike electrification, which works well for passenger vehicles, urban heating, and light industry, green hydrogen targets sectors where direct electrification is technically or economically impractical. India has large, established industrial footprints in precisely these sectors.

India's Green Hydrogen demand by sector – 2030 projections⁸ (million metric tonnes)

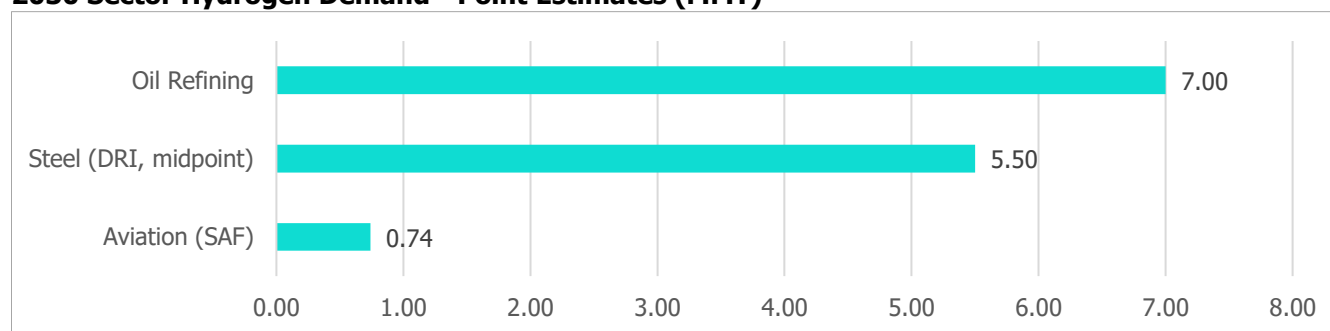
Sector	Current Feedstock	H2 Demand (2030 E)	Decarbonisation Horizon
Oil Refining	Grey hydrogen (Steam reforming)	~7 MMT	Near-term
Fertilisers/Ammonia	17-19 MMT ammonia consumption	Large – direct substitution	Near-term
Steel (DRI)	Coal-based blast furnaces	~5-6 MMT	Medium-term
Heavy Transport	Diesel (freight corridors)	Growing rapidly	Medium-term
Shipping/Ports	Heavy fuel oil (bunker)	Port hubs under development	Medium-term
Aviation (SAF)	Conventional jet fuel	0.74 MMT (2030) → 148.85 MMT (2050)	Long-term

⁶ Ministry of New and Renewable Energy (MNRE), Government of India, National Green Hydrogen Mission Notifications – Master policy framework, budgetary allocations, and the Strategic Interventions for Green Hydrogen Transition (SIGHT) operational criteria

⁷ MNRE, Green Hydrogen Certification Scheme of India (GHCI) official implementation gazette notifications

⁸ EY India, Green Hydrogen Sector Outlook: Investment Opportunities in India's Green Hydrogen Sector – Aggregated sector-by-sector domestic demand projections across hard-to-abate industrial grids

2030 Sector Hydrogen Demand - Point Estimates (MMT)



The **fertiliser sector** represents the most immediate, commercially viable demand pool. India consumes ~17–19 MMT of ammonia annually, largely produced using natural gas (domestic and imported LNG). Replacing even a fraction of this with green ammonia would reduce foreign exchange outflows, insulate India's agriculture sector from global gas price volatility, and simultaneously decarbonise a major emission source. The August 2025 SECI green ammonia auction, which discovered a record-low bid price of Rs 49.75/kg, less than half the price in the 2024 H2 Global tender, was a significant proof point that competitive green ammonia is achievable in India at scale⁹. Execution has since proved harder than the headline price suggested: the winning bids actually represent a 10–130% premium over India's own import prices, and 2 of the 13 off-takers have since withdrawn¹⁰.

For **steel**, the stakes are existential in a trade sense. India produced 164.9 million metric tonnes of steel in 2025 (provisional), the world's second-largest output and exports ~6-7 MMT annually¹¹. Its blast furnace-based production is substantially more carbon-intensive than EU counterparts. Under CBAM's definitive financial regime (active from January 2026), Indian steel exporters could face costs of \$70–\$190 per metric tonne on EU-bound shipments, rising above \$270 per tonne under default carbon values. The Indian Ministry of Steel has outlined a medium-term plan targeting green hydrogen and CCUS for steel decarbonisation by 2045, with emission intensity targets falling from 2.5 to 2.2 tonnes CO₂ per tonne of steel by 2030¹².

The Cost Reality: Where India Stands Today

Candour about costs is essential to any credible assessment of green hydrogen. Production costs in India are currently estimated at roughly Rs 350–450 per kg, against grey (fossil-based) hydrogen at Rs 160–200 per kg—a gap of roughly 2–2.5x¹³. According to RMI, stand-alone green hydrogen projects in India currently cost around US\$4.4–4.8/kg – broadly consistent with the rupee range above at current exchange rates¹⁴. However, this could decline to approximately US\$2.4/kg by 2030 as renewable electricity prices, electrolyser costs and project scale improve.

⁹ Solar Energy Corporation of India (SECI) & Press Information Bureau (PIB), Mode-2A Tranche-I Green Ammonia Auction Results, August 2025 (Recording the benchmark discovered bid price of ₹49.75/kg); supplemented by local tracking from pv magazine India

¹⁰ H2Global Foundation & Institutional Cleantech Deal Trackers – Documenting international import price premiums, execution criteria, and offtake agreement churn

¹¹ Ministry of Steel, Government of India, Overview of Steel Sector Update, April 2026, compiling provisional annual national output logs from the World Steel Association

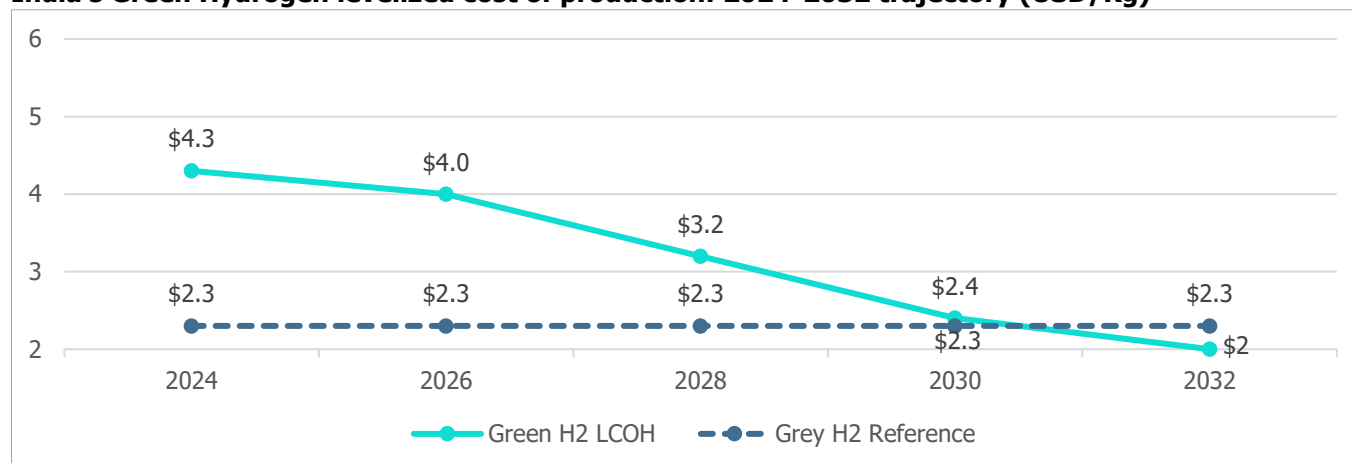
¹² Ministry of Steel, National Decarbonisation Roadmap for Core Metallurgy – Tracking primary steelmaker emission-intensity disclosures and alternative fuel shift limits

¹³ PIB India Factsheets / MNRE Rajya Sabha Session Submissions – Tracking discovered domestic commercial floor pricing levels and green vs grey production margins

¹⁴ RMI India, Green Hydrogen Production Pathways for India – Modeling localized levelized cost of hydrogen (LCOH) sensitivities, power transmission costs, and electrolyzer utilisation architectures

Consequently, project economics are now driven more by renewable electricity procurement strategy and electrolyser utilisation rates rather than by the electrolysis technology itself. This is where India holds a potential competitive advantage. With some of the world's lowest renewable energy tariffs and a target of 500 GW of non-fossil power capacity by 2030, India is well positioned to become one of the lowest-cost producers of green hydrogen globally. If realised, this cost advantage could support domestic decarbonisation and the development of export-oriented green hydrogen and green ammonia value chains.

India's Green Hydrogen levelized cost of production: 2024-2032 trajectory (USD/Kg)



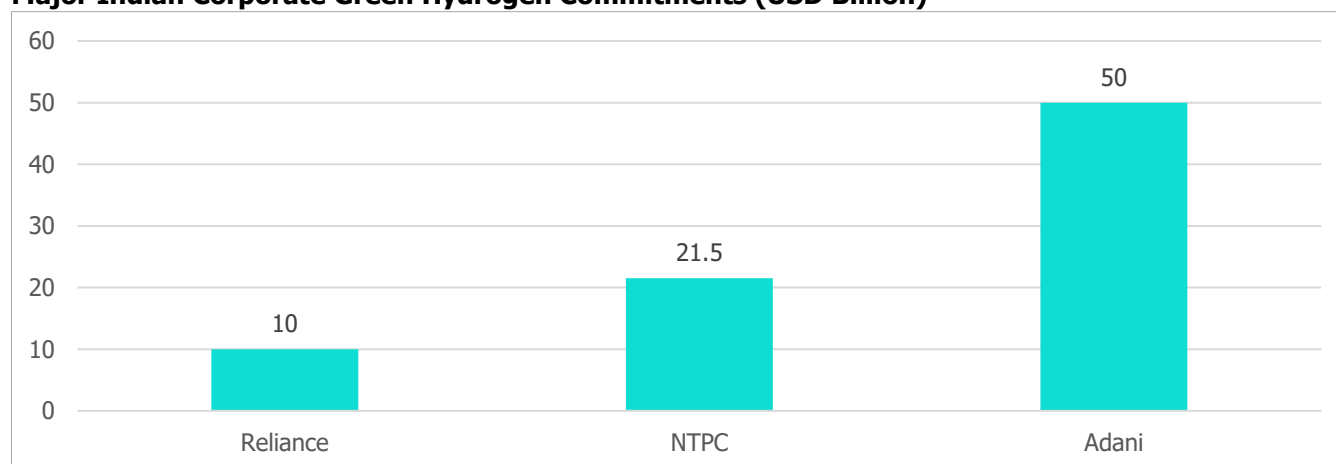
Corporate Commitments and the Investment Landscape

India's green hydrogen strategy is not purely governmental. The country's largest conglomerates have made material commitments. Reliance Industries has announced Rs 75,000 crore in a vertically integrated green energy ecosystem, with a stated target of \$1/kg hydrogen production cost by 2035. Adani Enterprises, through its Adani New Industries Ltd (ANIL) subsidiary, has committed to invest over \$50 billion over the next decade in green hydrogen, targeting 1 MMT of annual production by 2030; a proposed 25% equity stake in ANIL by France's TotalEnergies, announced alongside this target in 2022, was paused in 2023 pending an internal audit and has not been publicly confirmed as concluded since¹⁵. The \$50B figure continues to be reported as an Adani-funded commitment rather than a joint one. NTPC's renewable subsidiary is leading a ~US\$21–22 billion (Rs 1.85 lakh crore) green hydrogen hub in Andhra Pradesh, integrating 20 GW of renewable capacity and targeting 1,500 tonnes/day of hydrogen, with Phase 1 targeted for completion by 2027 and full completion by 2032.

Total private investment expected in India's green hydrogen sector through 2030 ranges between \$180–200 billion across production, electrolyzers, infrastructure, port upgrades, and renewable energy capacity¹⁶. While announced commitments substantially exceed FID-backed investments, they nevertheless indicate growing strategic interest from both public and private sector participants.

¹⁵ Adani Group & TotalEnergies, Corporate Joint Venture regulatory statements and audited asset allocation reports regarding Adani New Industries Ltd (ANIL)

¹⁶ Aggregated Institutional Energy Deal Trackers & Private Capital Allocation Logs – Documenting commercial commitments across generation assets, high-capacity pipeline networks, storage facilities, and deepwater port terminal transformations through 2030

Major Indian Corporate Green Hydrogen Commitments (USD Billion)**Policy, Regulation and International Standards**

India's regulatory architecture for green hydrogen is still evolving but has accelerated considerably since 2023. Key frameworks include the NGHM and the SIGHT programme (January 2023), the Green Hydrogen Certification Scheme of India (GHCI April 2025), MNRE waivers on inter-state transmission charges for open-access renewable energy used in hydrogen production, a reduced GST rate of 5% on hydrogen; and capital subsidies of 25–35% offered by individual states including Maharashtra, Uttar Pradesh, and Odisha for production projects.

Globally, the IRENA-led quality infrastructure roadmap for green hydrogen (2024) highlights the critical importance of harmonised definitions, Measurable-Reportable-Verifiable (MRV) standards, and internationally recognised certification for trade flows to function. The EU's Delegated Regulation on renewable hydrogen (2023) requires strict "additionality" (new renewable capacity must be created for hydrogen production), "temporal matching" (hourly matching of electricity consumption and generation), and "geographic correlation"¹⁷. India's GHCI framework will need to align progressively with these standards if Indian green hydrogen is to access premium European and Japanese markets.

¹⁷ European Parliament and Council, Regulation (EU) 2023/1184 (RFNBO Delegated Act) detailing additionality, temporal matching, and geographic correlation metrics; tracked alongside IRENA, Quality Infrastructure for the Green Hydrogen Economy (2024) roadmap frameworks

Key Challenges

Cost Competitiveness Gap	Execution vs. Announcement Gap	Electrolyser Supply Chain Risk
Green hydrogen remains materially costlier than grey hydrogen. Until this gap narrows, adoption is likely to depend on policy support, carbon pricing, or mandated demand.	By February 2026, only ~8,000 tonnes/year of green hydrogen had been commissioned against a 5 MMT/year 2030 target, requiring a near-exponential ramp-up from today's base.	India imports most electrolyser components: membranes, catalysts, and stacks. Domestic manufacturing is nascent, with 3 GW of awarded capacity yet to be commissioned and remains concentrated in alkaline technology.
Infrastructure and Demand Signal Deficit	Certification and Standard Lag	Policy Continuity Risk
Storage, distribution pipelines, and port handling infrastructure for green hydrogen barely exist in India. Without firm offtake agreements, capital won't flow at the scale required.	India's GHCI is a positive step, though full alignment with EU MRV standards, including hourly temporal matching, isn't yet in place, limiting access to premium export markets and green finance.	Long-cycle infrastructure projects need regulatory certainty across election cycles. India's record on sustaining incentives, as with solar and wind, is generally positive, though not without disruptions.

Inference & Analysis

Green hydrogen is not India's entire decarbonisation strategy, but it is central to its industrial competitiveness narrative. The combination of CBAM exposure for Indian industry, the net-zero 2070 commitment, an abundance of low-cost renewable resources, and a government policy framework with genuine financial backing creates preconditions few other emerging economies can match.

The risks are real and structural: the cost gap with grey hydrogen remains significant, the execution record has lagged ambition, and the certification infrastructure needed for premium export markets is still incomplete. These are specific, manageable challenges that policymakers, DFIs, and industrial capital allocators need to address with precision.

India's solar industry followed exactly this arc: from 2010's Rs 17/unit to below Rs 2/unit today, from near-zero manufacturing to the world's third-largest solar market. Green hydrogen's physics are harder, its value chain more complex, and its timeline longer. But the structural logic is the same, and the policy architecture, corporate commitment, and global market pull are now sufficiently aligned that the trajectory is likely to steepen from here, much as it did for solar. While the pace and scale of deployment remain uncertain, the strategic relevance of green hydrogen within India's industrial decarbonisation agenda is becoming increasingly difficult to ignore.

Green hydrogen's growth is close to a given; the real question for ESG-oriented investors and industrial strategists is where value creation will concentrate across the value chain. Production, equipment manufacturing, and end-use applications will not scale equally, and capital efficiency will vary significantly across them.

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