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Green Hydrogen: India's Rs 8 Lakh Crore Bet on the Energy Future

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MAINS RELEVANCE:

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INTERVIEW ANGLE

"Is India's green hydrogen ambition economically realistic, or is it a policy narrative chasing a distant technology dream?"

The announcement at the Andhra Pradesh Global Investors Summit of a one-million-tonne-per-annum green hydrogen deal between AM Green and NTPC is symbolically significant. But symbols must eventually become balance sheets. India has announced a **National Green Hydrogen Mission** with a target of 5 MMTPA by 2030 and a projected investment of Rs 8 lakh crore — roughly equivalent to the entire annual revenue receipts of the central government. Whether this ambitious bet pays off depends on whether India can navigate three simultaneous challenges: cost, infrastructure, and geopolitics.

THE COST PROBLEM IS REAL — AND TRACTABLE

The fundamental economics of green hydrogen are straightforward: it is too expensive. Green hydrogen in India currently costs between \$3 and \$6 per kg to produce. Grey hydrogen — produced by steam reforming of natural gas — costs \$1 to \$2 per kg. No industrial buyer will voluntarily switch to a fuel that costs 2–5 times more, absent a carbon price or regulatory mandate.

The target of **\$1 per kg green hydrogen by 2030** — India's "1-1-1" vision (1 dollar, 1 kilogram, 1 decade) — is not impossible. Electrolyser costs have fallen from over \$1,000 per kW in 2015 to approximately \$800 per kW today, following the same learning curve that solar panels traced — solar fell from \$8 per watt in 2010 to under \$0.20 per watt by 2024. If green hydrogen electrolyser costs reach \$300–400 per kW and solar power costs stay near Rs 1.5–2 per unit in India's high-radiation zones, the arithmetic of \$1/kg hydrogen begins to work.

The SIGHT programme's production-linked incentives — effectively a subsidy to bridge the cost gap — are a reasonable temporary mechanism to accelerate scale and drive down learning-curve costs. The critical question is whether the incentive duration is long enough and the offtake predictable enough to justify the capital commitment that large electrolyser manufacturing requires. India's industrial policy credibility — its ability to signal stable, long-term policy — is being tested here.

THE INFRASTRUCTURE GAP

The AM Green Kakinada project is technically impressive. But a 1 MMTPA green hydrogen facility requires:

- Approximately **5 GW** of dedicated renewable power generation — roughly equal to India's total installed offshore wind capacity target for 2030
- Seawater desalination (or fresh water access) for ~9 litres of pure water per kg of hydrogen
- Pipeline or marine terminal infrastructure for green ammonia export
- Port upgrades at Kakinada for high-pressure cryogenic or ammonia tanker logistics

India's infrastructure delivery record is improving — the roads programme under Gadkari, metro rail expansion, and renewable energy tendering have all demonstrated institutional capacity gains. But the **transmission infrastructure for renewable energy** — the grid connectivity to move power from solar-rich western India to consumption or electrolysis points — remains a binding constraint. The Green Energy Corridor programme (Phase I and II) is addressing this, but the pace of transmission additions has lagged generation additions for years.

Water is the other infrastructure problem. Electrolysis consumes water at scale. For a 5 MMTPA national hydrogen programme, the total water requirement is approximately **45 million tonnes per year** of pure water. In water-scarce coastal locations, this means desalination — with its own energy requirements (adding a circular cost). Inland locations face fresh water availability trade-offs with agriculture and urban supply.

THE EXPORT MARKET AND CBAM

India's green hydrogen ambition is explicitly export-oriented: the target is Rs 1 lakh crore in exports by 2030. The logic is sound in principle. The EU's **Carbon Border Adjustment Mechanism (CBAM)**, which entered into effect in 2026, imposes carbon levies on imported goods from sectors including fertilisers, steel, and cement. Indian exporters using grey hydrogen (or grey energy inputs) will face higher EU border costs, while those using green hydrogen will be exempt or face lower levies. The incentive to switch is real — but the speed of that switch is constrained by the current green hydrogen cost premium.

The deeper question is whether Japan, South Korea, and Germany — the three largest announced green hydrogen import markets — will actually follow through on their import targets. All three have made policy commitments (Germany's H2Global programme, Japan's Basic Hydrogen Strategy 2023) but import prices remain contested. Germany has a target of **1 million tonnes of green hydrogen imports by 2030** — India is one of multiple potential suppliers competing with Australia, Chile, Morocco, and the Gulf states.

India's **cost advantage** over, say, Australia (high labour costs, strong environmental regulation) or Chile (smaller economy, infrastructure deficit) is its solar resource quality and the scale of its potential electrolyser manufacturing (driven by PLI incentives). But India also faces a **reliability premium**: buyers in Germany and Japan will demand firm contracts with delivery guarantees. India's history of infrastructure project delays is a reputational headwind that deal-making like AP GIS 2026 must overcome.

THE DOMESTIC DECARBONISATION CASE

Beyond exports, green hydrogen's most defensible near-term use case is **domestic industrial decarbonisation**:

Fertilisers: India produces ~25 million tonnes of urea annually, all using grey hydrogen. A mandatory blending trajectory — requiring, say, 5% green hydrogen in urea production by 2028, rising to 100% by 2040 — would create a large, stable domestic demand signal that would underpin investment in electrolyser manufacturing without requiring international competitiveness from day one.

Refineries: Indian Oil, HPCL, and BPCL collectively consume millions of tonnes of grey hydrogen. Their captive green hydrogen production, enabled by PLI incentives, would serve a double purpose: industrial decarbonisation and electrolyser scale-up.

Steel: The steel sector is responsible for approximately 8% of India's CO₂ emissions. The transition to green DRI (Direct Reduced Iron) using green hydrogen is technically feasible — SAIL and JSW Steel have both announced pilots — but requires massive capital expenditure. Blended financing from development finance institutions (DFIs) like IFC and ADB is essential here.

WHAT POLICY MUST DELIVER

1. A Stable Demand Signal

Without committed domestic offtake — through mandates, carbon prices, or long-term power purchase agreements — the investment case for green hydrogen remains speculative. A phased mandatory blending mandate for urea, refineries, and steel would create the demand foundation.

2. Electrolyser Manufacturing at Scale

India has the potential to become a large-scale electrolyser manufacturer, driving down global costs and creating export revenue. This requires consistent PLI disbursements, resolution of port and logistics costs for importing critical materials (platinum-group metals for PEM electrolysers), and strong standards certification.

3. Water Governance

A national policy for seawater desalination for green hydrogen projects — with environmental clearances, energy efficiency standards, and brine disposal protocols — would resolve the water constraint without creating a new environmental problem.

4. Grid and Transmission

The Green Energy Corridor must be fully commissioned and expanded. Green hydrogen at scale is meaningless without dedicated renewable power corridors connecting Rajasthan and Gujarat solar zones to electrolysis facilities on the eastern and western coasts.

The Rs 8 lakh crore bet is defensible — but only if the policy ecosystem around it is coherent and sustained. Green hydrogen is not a 5-year policy cycle deliverable; it is a 15-year structural transition. India’s institutional capacity for sustained, multi-government-term industrial policy — historically the weakest link in its economic governance — will be the true test of whether the Kakinada ambition becomes a Kakinada reality.

★ FACTS CORNER — KNOWLEDGE PEDIA
NGHM — CORE DATA:

Launch: January 4, 2023
 Ministry: MNRE
 Production target: 5 MMTPA by 2030
 Government outlay: Rs 19,744 crore
 Expected investment: Rs 8 lakh crore (\$100B) by 2030
 Export target: Rs 1 lakh crore/year by 2030
 RE addition needed: ~125 GW (to power electrolyzers)

COST TRAJECTORY:

Current green H₂ cost in India: \$3–6/kg
 Grey H₂ cost: \$1–2/kg
 India's target: \$1/kg by 2030 ("1-1-1" vision)
 Electrolyser costs: ~\$800/kW today; target \$300–400/kW

SIGHT PROGRAMME:

Component A: incentive for domestic electrolyser manufacturing
 Component B: incentive for green H₂ production
 Mode I + Mode II: competitive bidding + indigenous electrolyser link

KEY APPLICATIONS (HARD-TO-ABATE SECTORS):

Fertilisers: replace grey H₂ in urea (India: ~25 MT urea/year)
 Refineries: IOCL, HPCL, BPCL — large grey H₂ users
 Steel: DRI (Direct Reduced Iron) with green H₂ replaces coking coal
 Shipping: IMO 2050 net-zero; green ammonia as marine fuel

CBAM (EU CARBON BORDER ADJUSTMENT):

Effective: 2026
 Sectors: steel, cement, aluminium, fertilisers, electricity, hydrogen
 Impact on India: exporters must prove low-carbon inputs or pay border levy

EXPORT COMPETITION:

Competing with: Australia, Chile, Morocco, Gulf states (UAE, Saudi Arabia)
 Germany H₂Global programme: target 1 MT imports by 2030
 Japan Basic Hydrogen Strategy 2023: large import targets

INFRASTRUCTURE REQUIREMENTS (AT 5 MMTPA SCALE):

Dedicated RE capacity: ~125 GW
 Water: ~45 million tonnes pure water/year
 Green Energy Corridor: Phase I + II for RE transmission

OTHER RELEVANT FACTS:

AM Green: formerly AmpIn Energy Transition; Kakinada project 1 MMTPA; partner NTPC Green
 NTPC Green Energy Ltd: subsidiary of NTPC; manages RE + green H₂ portfolio

PLI for electrolyzers: production-linked incentive under NGHM

IFC + ADB blended finance: essential for green steel and DRI capital investment

Green ammonia: NH_3 using green H_2 + air nitrogen via Haber-Bosch; leading export carrier

Sources: The Hindu, MNRE, PIB

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