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# India's Green Hydrogen Bet: AM Green Kakinada and the NGHM

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# India's Green Hydrogen Bet: AM Green Kakinada and the NGHM

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**WHY IN NEWS**

At the Andhra Pradesh Global Investors Summit 2026, AM Green (formerly AmpIn Energy Transition) signed a landmark 1 million metric tonne per annum green hydrogen supply agreement with NTPC Green Energy Limited for its Kakinada facility — one of the largest announced green hydrogen projects in India under the National Green Hydrogen Mission.

## WHAT IS GREEN HYDROGEN?

**Hydrogen** ($H_2$) is the lightest element in the universe and, when burned or used in a fuel cell, produces only water vapour — making it a potentially clean fuel. The challenge is production: almost all hydrogen currently produced globally (about 96%) is "grey hydrogen" — produced from natural gas via steam methane reforming (SMR), releasing significant $CO_2$.

The "colour taxonomy" of hydrogen:

| Colour | Source | Carbon Emissions |
|---|---|---|
| Grey | Natural gas (SMR) | High (~10 kg $CO_2$ per kg $H_2$) |
| Blue | Natural gas + Carbon Capture and Storage (CCS) | Low (CCS captures ~90%) |
| Green | Electrolysis of water using renewable electricity | Zero |
| Pink/Red | Nuclear energy-powered electrolysis | Zero |
| Turquoise | Methane pyrolysis | Solid carbon (not $CO_2$) |

**Green hydrogen** is produced by passing renewable electricity through an **electrolyser** that splits water molecules ($H_2O$) into hydrogen ($H_2$) and oxygen ($O_2$). No fossil fuels are involved; the only by-product is oxygen.

### The Electrolyser Types

| Technology | Efficiency | Cost | Status |
|---|---|---|---|
| Alkaline (AEL) | 60–70% | Lowest | Commercial |
| Proton Exchange Membrane (PEM) | 65–80% | Higher | Commercial; fast response |
| Solid Oxide (SOEC) | 70–85% | Highest | Early commercial |
| Anion Exchange Membrane (AEM) | 65–75% | Medium | Emerging |

India's electrolyser manufacturing capacity is being incentivised under the NGHM's **Strategic Interventions for Green Hydrogen Transition (SIGHT)** component — production-linked incentives for electrolyser and green hydrogen manufacturers.

## THE KAKINADA PROJECT — AM GREEN AND NTPC

### AM Green (Kakinada Hub)

**AM Green** (formerly AmpIn Energy Transition, rebranded) is developing the **Kakinada Green Hydrogen Hub** — an integrated facility that combines:

- **Solar and wind power generation** (captive renewable generation) on the Andhra Pradesh coast
- **Electrolysis** using approximately 5 GW of electrolyser capacity
- **Green ammonia production**: the hydrogen is combined with nitrogen (from air separation) in a modified Haber-Bosch process to produce ammonia ($NH_3$)
- **Export terminal**: Kakinada deep-water port is being upgraded for liquefied green ammonia and potentially liquid hydrogen exports

**Target output:** 1 million metric tonnes per annum (MMTPA) of green hydrogen (or equivalent green ammonia).

### NTPC Green Energy Limited

**NTPC Green Energy Limited (NGEL)** is a wholly-owned subsidiary of **NTPC** (formerly National Thermal Power Corporation, now just NTPC Limited), established to manage NTPC's renewable energy and green hydrogen portfolio. NTPC has announced targets of:

- 60 GW of renewable capacity by 2032
- Multiple green hydrogen projects across India (Leh, Rajasthan, Andhra Pradesh)

Under the MoU signed at AP GIS 2026, NTPC Green Energy will be an **offtake partner** — purchasing the green hydrogen or ammonia from AM Green for onward use in NTPC's own operations (replacing grey hydrogen in fertiliser plants or for blending in gas turbines) and for commercial sale.

## NATIONAL GREEN HYDROGEN MISSION (NGHM)

Launched on **January 4, 2023**, the National Green Hydrogen Mission is India's flagship policy for developing a green hydrogen ecosystem. Key parameters:

| Metric | Target |
|---|---|
| Green hydrogen production | 5 MMTPA by 2030 |
| Renewable energy addition | ~125 GW (to power electrolysers) |
| Electrolyser manufacturing | 5 GW/year domestic capacity by 2030 |
| Cumulative investment | Rs 8 lakh crore ($100 billion) by 2030 |
| Total government outlay | Rs 19,744 crore |
| Exports target | ~Rs 1 lakh crore/year by 2030 |
| Employment generated | ~6 lakh direct/indirect jobs |

The mission is implemented by the **Ministry of New and Renewable Energy (MNRE)**.

### SIGHT Programme (Under NGHM)

**Strategic Interventions for Green Hydrogen Transition (SIGHT)** is the main incentive programme under NGHM:

**Component A**: incentive for domestic electrolyser manufacturing (Rs per kg capacity manufactured)

**Component B**: incentive for green hydrogen production (Rs per kg $H_2$ produced)

**Mode I (SIGHT)**: procurement through competitive bidding for renewable energy and electrolyser packages

**Mode II (SIGHT)**: incentive for green hydrogen produced from indigenous electrolysers

## WHY GREEN HYDROGEN MATTERS FOR INDIA

### Decarbonising Hard-to-Abate Sectors

Green hydrogen cannot easily replace coal and gas in power generation — batteries and direct electrification are more efficient there. Its promise lies in sectors that cannot be easily electrified:

**Fertilisers**: Ammonia production (for urea and DAP) consumes ~50% of all hydrogen globally. India produces about 25 million tonnes of urea annually — all using grey hydrogen. Green ammonia would decarbonise this at source.

**Steel**: Direct Reduced Iron (DRI) process using green hydrogen instead of coking coal. SAIL, Tata Steel, and ArcelorMittal have pilot projects.

**Shipping**: Green ammonia as ship fuel — the International Maritime Organization (IMO) has mandated net-zero emissions from shipping by 2050.

**Refineries**: Indian Oil, HPCL, and BPCL refineries use large quantities of grey hydrogen. Green hydrogen substitution would significantly cut refinery emissions.

### Export Opportunity

The EU's **Carbon Border Adjustment Mechanism (CBAM)** — effective from 2026 — will impose carbon levies on imports of steel, cement, aluminium, fertilisers, and electricity from non-EU countries unless those countries have equivalent carbon pricing. This creates a powerful incentive for Indian exporters to adopt green hydrogen-based production.

The EU, Japan, and South Korea have announced ambitious green hydrogen import targets. India, with its abundant solar and wind resources (particularly in Rajasthan, Gujarat, and the AP-TN coast), has a natural cost advantage — if electrolyser costs continue to fall and the transmission infrastructure is built.

### Challenges

**Cost**: Green hydrogen currently costs $3–6 per kg in India. Grey hydrogen costs $1–2 per kg. The target is **$1 per kg green hydrogen by 2030** ("1-1-1" vision: 1 kg for $1 by 2030). Achieving this requires:

Solar power at Rs 1.5–2/unit (currently achievable)

Electrolyser costs below $300/kW (from current ~$800/kW)

Financing costs at development finance rates (not commercial lending rates)

**Water**: Electrolysis consumes ~9 litres of pure water per kg of hydrogen. In water-scarce areas, this requires seawater desalination — adding cost and energy consumption.

**Storage and Transport**: Hydrogen is the lightest molecule — difficult to store and transport. Liquid hydrogen requires cryogenic storage (-253°C). Green ammonia is the leading carrier for export trade.

## UPSC RELEVANCE

**Prelims:**

NGHM: launched January 4, 2023; 5 MMTPA target; Rs 19,744 crore outlay; MNRE

SIGHT programme: two components (electrolyser manufacturing + $H_2$ production)

Green hydrogen = electrolysis using renewable energy

NTPC Green Energy Ltd: subsidiary of NTPC for renewables

Kakinada port: Andhra Pradesh; deep-water; LNG and green energy export hub

CBAM: EU Carbon Border Adjustment Mechanism (effective 2026)

**Mains GS-3:** National hydrogen policy; India's energy transition; decarbonising hard-to-abate sectors (fertilisers, steel, shipping); export potential; clean energy investment; CBAM implications for Indian industry

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### GREEN HYDROGEN — CORE DATA:

Production: electrolysis of water using renewable electricity

By-product: oxygen only (no $CO_2$)

Current cost in India: $3–6/kg (target: $1/kg by 2030)

Grey hydrogen cost: $1–2/kg (natural gas + SMR)

### NATIONAL GREEN HYDROGEN MISSION (NGHM):

Launch date: January 4, 2023

Ministry: MNRE (Ministry of New and Renewable Energy)

Production target: 5 MMTPA by 2030

RE addition: ~125 GW to power electrolysers

Domestic electrolyser capacity: 5 GW/year by 2030

Government outlay: Rs 19,744 crore

Expected investment: Rs 8 lakh crore ($100B) by 2030

Jobs: ~6 lakh (direct + indirect)

### SIGHT PROGRAMME (UNDER NGHM):

Component A: incentive for electrolyser manufacturing

Component B: incentive for green H2 production

Bidding: competitive tender mechanism

### AM GREEN KAKINADA PROJECT:

Output: 1 MMTPA green hydrogen / green ammonia

Electrolyser capacity: ~5 GW

Partner: NTPC Green Energy Limited (offtake)

Location: Kakinada, Andhra Pradesh

### ELECTROLYSER TYPES:

Alkaline (AEL): cheapest; commercial

PEM (Proton Exchange Membrane): fast response; commercial

SOEC (Solid Oxide): highest efficiency; early commercial

AEM (Anion Exchange Membrane): emerging

### HARD-TO-ABATE SECTORS (H2 APPLICATIONS):

Fertilisers: green ammonia replacing grey H2 in urea production

Steel: direct reduced iron (DRI) replacing coking coal

Shipping: IMO 2050 net-zero mandate; green ammonia as fuel

Refineries: replacing grey H2 in hydrocracking/desulphurisation

### CBAM (EU CARBON BORDER ADJUSTMENT MECHANISM):

Effective: 2026 (full implementation)

Sectors: steel, cement, aluminium, fertilisers, electricity, hydrogen

Implication: Indian exporters face carbon levy unless they decarbonise

**OTHER RELEVANT FACTS:**

NTPC full name: no longer stands for “National Thermal Power” — rebranded to just NTPC Limited

NTPC RE target: 60 GW by 2032

Water for electrolysis: ~9 litres pure water per kg $H_2$

Green ammonia: $H_2 + N_2$ via Haber-Bosch using renewables; leading $H_2$ export carrier

IMO 2050 target: net-zero GHG from international shipping

Sources: PIB, MNRE, The Hindu

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