Unlocking India’s Green Hydrogen Production Potential

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1. Key Takeaways

- **India aims to produce 5 million metric tonnes (MMT) of Green Hydrogen annually by 2030.**
- **Port-based Green Hydrogen pilots** have been launched at
    - V.O. Chidambaranar Port (Tamil Nadu)
    - Deendayal Port Authority, Kandla (Gujarat)
- **Hydrogen mobility pilots** are running on **10 routes**, using **37 hydrogen vehicles** (fuel cell + hydrogen ICE).
- The Mission is expected to attract **₹8 lakh crore investment**, generate **6 lakh jobs**, and reduce fossil fuel imports by **₹1 lakh crore annually**.

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2. Introduction

- India is undergoing a major **energy transition** to reduce fossil fuel dependence and move toward **Net Zero by 2070**.
- In this shift, **Green Hydrogen (GH2)** has emerged as a strategic fuel to decarbonize:
    - Fertilizers
    - Refineries
    - Steel
    - Long-haul mobility
    - Shipping
- To build a national ecosystem around hydrogen, the Government launched the **National Green Hydrogen Mission (NGHM)** in **2023**.

Mission Vision:

- Energy security

- Reduced import dependence
- Global leadership in hydrogen
- Industrial competitiveness
- Transition to a low-carbon economy

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3. What is Green Hydrogen?

Green Hydrogen is hydrogen produced using **renewable energy**.

Process

- Water is split into hydrogen + oxygen using **electrolysis**, powered by:
    - Solar
    - Wind
    - Hydro
- Hydrogen qualifies as “Green” if **life-cycle emissions ≤ 2 kg CO_2 per kg of H_2**.

Other sources

- Biomass → Hydrogen (also allowed if emission limits are met).

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4. Targets and Scale of the Mission

By **2030**, India aims to achieve:

- **5 MMT annual GH2 production**
- **125 GW** of renewable energy capacity dedicated to GH2
- **₹8 lakh crore+ investments**
- **6 lakh new jobs**
- **Reduction of 50 MMT CO_2 emissions per year**
- **Reduced fossil-fuel imports by ₹1 lakh crore annually**

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5. Institutional Achievements (as of May 2025)

- **19 companies** awarded **8.62 lakh tonnes/year GH2 production capacity**
- **15 firms** allocated **3,000 MW electrolyzer manufacturing capacity**
- Pilot projects operational in:
    - **Steel**
    - **Shipping**
    - **Road transport**

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6. Components of NGHM

The Mission is built on four pillars:

1. Policy and Regulatory Framework

- Clear standards
- Certification
- Transmission charge waivers
- Open Access reforms

2. Demand Creation

- Incentives to replace grey hydrogen (from natural gas) in industries
- Support for green ammonia in fertilizers

3. R&D and Innovation

- Funding, technology development, safety systems

4. Infrastructure

- Hydrogen hubs
- Storage systems

- Refueling corridors

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7. Major Schemes Under the Mission

(i) SIGHT Scheme (₹17,490 crore)

Strategic Interventions for Green Hydrogen Transition

- Incentives for:
    - Domestic electrolyzer manufacturing
    - Production of green hydrogen and green ammonia

(ii) Development of Green Hydrogen Hubs

Three ports designated as GH2 hubs (Oct 2025):

1. **Deendayal Port, Gujarat**
2. **V.O. Chidambaranar Port, Tamil Nadu**
3. **Paradip Port, Odisha**

Purpose

- Integrated centres for production, storage, consumption, and export.

(iii) Green Hydrogen Certification Scheme (GHCI), 2025

- Certifies hydrogen as “green” based on life-cycle emissions.
- Mandatory for:
    - Any plant availing incentives
    - Any domestic sale
- **Bureau of Energy Efficiency (BEE)** is the nodal authority.

(iv) Strategic Hydrogen Innovation Partnership (SHIP)

- Public–private R&D collaboration

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- Involves:
    - BARC
    - ISRO
    - CSIR
    - IITs, IISc
- Focus: advanced hydrogen technologies.

R&D Funding

- **₹400 crore** powering **23 projects** on safety, storage, and production
- **₹100 crore** scheme for hydrogen start-ups
- International collaboration via **EU–India TTC**

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8. Sectoral Applications

A. Industrial Applications

1. Fertilizers

- Green ammonia auctions: **7.24 lakh tonnes/year** at **₹55.75/kg**

2. Petroleum Refineries

- Gradual shift from grey to green hydrogen
- Reduces carbon intensity of refining operations

3. Steel

- 5 industrial pilots evaluating:
    - Direct reduction of iron using GH2
    - Safety
    - Cost feasibility

B. Mobility and Transport

1. Road Transport

- 37 hydrogen vehicles under trial:
    - **15 fuel cell vehicles**
    - **22 hydrogen-ICE vehicles**
- 9 refueling stations
- **₹208 crore** financial support

2. Shipping

V.O. Chidambaranar Port

- 10 Nm^3/hr Green Hydrogen plant
- Cost: **₹25 crore**

Deendayal Port (Kandla)

- Megawatt-scale GH2 facility
- Cost: **₹13 crore**
- Output: **140 tonnes/year**

Green Methanol Bunkering (₹42 crore)

- Supports **Kandla–Tuticorin Green Shipping Corridor**

3. High Altitude Mobility (Leh, 3,650 m)

- NTPC pilot:
    - 5 hydrogen buses
    - GH2 fueling station
- Mitigation: **350 MT CO_2/year**

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- Produces **230 MT oxygen/year** (equivalent to **13,000 trees**)

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9. Enabling Framework

Policy Measures

- Waiver of **interstate transmission charges** for renewable energy used in GH2
- Time-bound **open access approvals**

Skill Development

- Over **5,600 trainees certified** in hydrogen-related skills
- Curriculum designed with:
    - NSDC
    - Sector Skill Councils
    - Industry partners

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10. International Partnerships

1. World Hydrogen Summit (2024)

- India Pavilion inaugurated
- Boosts global engagement

2. EU–India Trade and Technology Council

- Over 30 joint hydrogen proposals

3. India–UK Standards Partnership

- Cooperation on:
    - Safety codes
    - Regulations
    - Certification standards

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4. Partnership with Germany’s H2Global

- Joint tender designs for hydrogen exports
- SECI signed an MoU (2024)

5. Singapore Collaboration (2025)

- Sembcorp to develop hydrogen/ammonia hubs at:
    - Tuticorin
    - Paradip

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11. Conclusion

Green Hydrogen forms the backbone of India’s emergence as a **clean-energy leader**. The National Green Hydrogen Mission integrates:

- Energy security
- Industrial transformation
- Emissions reduction
- Job creation
- Global competitiveness

With strong renewable energy capacity, robust policy support, and expanding international partnerships, India is positioning itself to become a **major global producer and exporter** of green hydrogen and its derivatives.

The Mission represents a decisive step toward a **sustainable, secure, and self-reliant future**—aligning with the vision of a **Viksit Bharat by 2047** and India’s **Net Zero 2070 commitment**.

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