

# Future of Green Hydrogen Energy in India

## Executive Summary

Green hydrogen, produced via electrolysis using renewable energy, is emerging as a cornerstone of India's strategy to achieve energy independence and net-zero emissions by 2070. With ambitious targets under the National Green Hydrogen Mission (NGHM), India aims to produce 5 million metric tonnes per annum (MMTPA) of green hydrogen by 2030, positioning itself as a potential global exporter. Significant progress has been made, with 862,000 tonnes per annum (TPA) of production capacity and 3,000 MW of electrolyser manufacturing capacity allocated. However, challenges such as high production costs, infrastructure limitations, and global market competition remain. This report explores India's green hydrogen potential, key initiatives, challenges, opportunities, and future outlook, supported by recent developments and expert insights.

## 1. Introduction

Green hydrogen is a clean energy carrier produced by splitting water using renewable electricity, offering applications in industries, transport, and power generation. India's abundant renewable energy potential (targeting 500 GW by 2030) and strategic policies position it as a leader in the global green hydrogen economy. The NGHM, launched in 2023, aims to decarbonize sectors like steel, ammonia, and transport while fostering economic growth and job creation. This report assesses the drivers, progress, challenges, and future trajectory of green hydrogen in India.

## 2. Current State of Green Hydrogen in India

### 2.1 Policy Framework

- **National Green Hydrogen Mission (NGHM):**
  - Launched in January 2023 with a budget of INR 19,744 crore (approx. \$2.4 billion).
  - Targets: 5 MMTPA green hydrogen production and 125 GW of renewable energy capacity for electrolysis by 2030.
  - Incentives: Subsidies for electrolyser manufacturing, tax breaks, and demand-side incentives for green hydrogen use.
- **Progress:**
  - 862,000 TPA production capacity allocated to 19 companies.
  - 3,000 MW annual electrolyser manufacturing capacity allocated to 15 firms.
  - Pilot projects in steel, shipping, and refineries underway.

## 2.2 Industry Developments

- Major players like Reliance Industries, Adani Group, and NTPC are investing in green hydrogen projects.
- International partnerships (e.g., India-Netherlands Dialogue) aim to enhance technology transfer and market access.
- Renewable energy capacity expansion (from 120 GW to 500 GW by 2030) supports green hydrogen production.

## 2.3 Investment and Job Creation

- \$100 billion investment sought by 2030 to meet NGHM targets.
- Expected to create 600,000 jobs, fostering a robust hydrogen ecosystem.

# 3. Opportunities

- **Energy Independence:** Green hydrogen reduces reliance on imported fossil fuels, aligning with India's energy security goals.
- **Export Potential:** India aims to become a global green hydrogen exporter by 2030, leveraging low-cost renewable energy.
- **Decarbonization:** Applications in hard-to-abate sectors like steel, cement, and heavy transport.
- **Economic Growth:** Investments in electrolyser manufacturing and infrastructure drive industrial development.

# 4. Challenges

- **High Costs:** Green hydrogen production costs (\$4–6/kg) are higher than grey hydrogen (\$1–2/kg), requiring cost reductions via economies of scale and technological advancements.
- **Infrastructure Gaps:** Limited hydrogen transport and storage infrastructure hinders scalability.
- **Global Competition:** Countries like Australia and Saudi Arabia are also targeting export markets, posing competitive challenges.
- **Energy Demand:** Scaling to 5 MMTPA requires significant renewable energy capacity, straining grid infrastructure.

# 5. Future Outlook

- **Cost Reduction:** Advances in electrolyser efficiency and declining renewable energy costs could lower green hydrogen prices to \$1–2/kg by 2030.
- **Infrastructure Development:** Investments in pipelines, storage, and refueling stations are critical for adoption.
- **Global Leadership:** India's low-cost solar and wind energy, combined with strategic policies, positions it to capture 10–15% of the global green hydrogen market by 2035.
- **Innovation:** R&D in alkaline and solid oxide electrolyzers, alongside green ammonia production, will drive scalability.

## 6. Recommendations

- **Policy Support:** Extend subsidies and create demand mandates for green hydrogen in industries.
- **Public-Private Partnerships:** Collaborate with global leaders to accelerate technology adoption.
- **Infrastructure Investment:** Prioritize hydrogen pipelines and storage facilities.
- **R&D Focus:** Invest in next-generation electrolyzers and green ammonia technologies.

## 7. Conclusion

India's green hydrogen ambitions, backed by the NGHM and significant investments, position it as a potential global leader. While challenges like high costs and infrastructure gaps persist, strategic policies and renewable energy growth provide a strong foundation. By addressing these hurdles, India can achieve energy independence, decarbonize key sectors, and emerge as a green hydrogen export hub by 2030.

## References

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