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Review of India's Green Hydrogen Mission

Advancing the Net-Zero Agenda through Regional Cooperation in Green Hydrogen in Asia
August 23, 2023

About WRI

WRI is a research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being

We work with governments, businesses, multilateral institutions and civil society to improve people's lives and protect nature.

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National Green Hydrogen Mission

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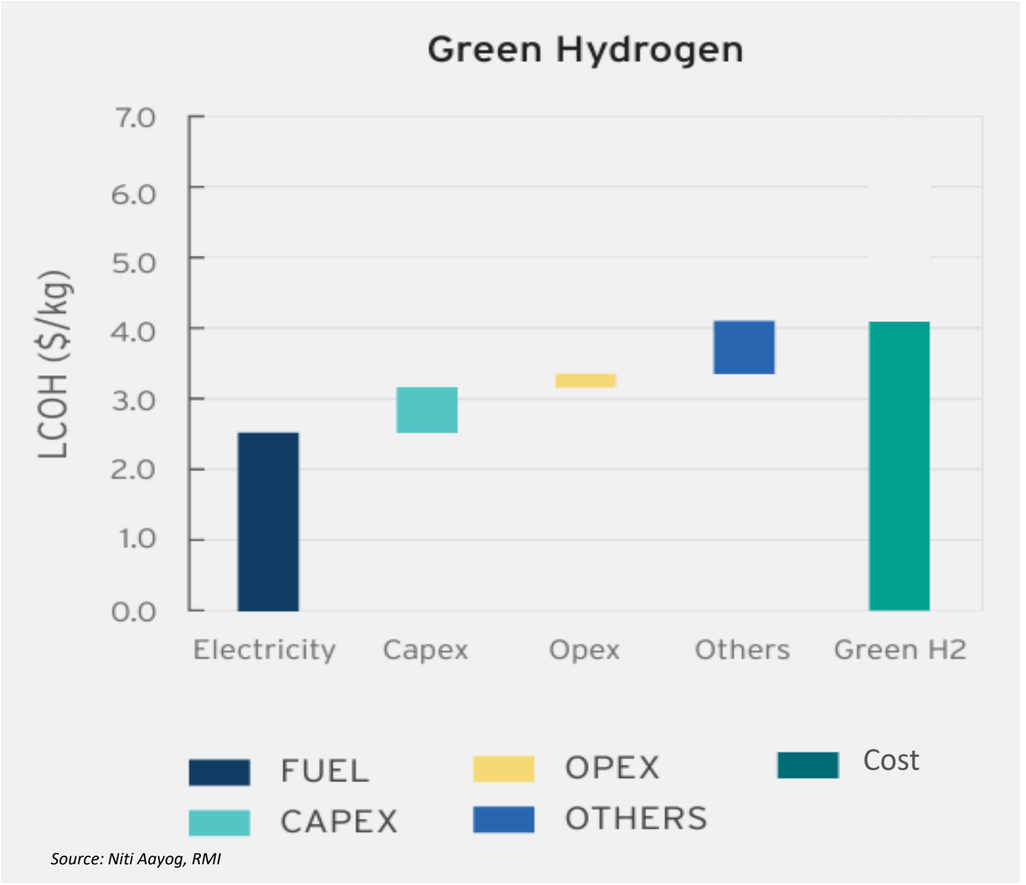
India's Focus on Green Hydrogen

Reduce Import of Crude Oil and Fertilizers
Import dependance on Ammonia and natural gas for hydrogen production

Low Cost and Vast RE reserves
Wind Tariffs : 2.9 Rs/kWh (2023)
Solar Tariffs: 2.5 Rs./ kWh (2023)

Rapid Technology Cost Decline Predicted
Cost of electrolysers expected to decline significantly with economies of Scale

Meet Climate Goals and Net Zero Target



Source: Niti Aayog, RMI

Renewable electricity comprises more than 60% of the cost of green hydrogen production.

National Green Hydrogen Mission (1/2)

Demand Creation

Export Markets

Capturing Global Demand

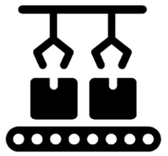
Substituting imports

Fossil Fuels and Fertilizers

Domestic Demand

Cross Sectoral Applications

Incentivizing Supply



Strategic Interventions for GH2 Transition (SIGHT)

Direct Financial Incentives for:

- ❑ **Electrolyzer Manufacturing**
- ❑ **Green Hydrogen Production**

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National Green Hydrogen Mission (2/2)

Key Enablers

Resources

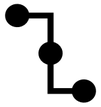
Renewable energy - banking & storage, transmission, finance, land, water

R&D

Result oriented, time-bound outputs (PPP, grand challenges etc.)

Ease of doing business

Simpler procedures, taxation, SEZ, commercial issues, single window clearances



Infrastructure & Supply Chain

Ports, Re-fueling, Hydrogen Hubs, pipelines

Regulations & Standards

Testing facilities, standards, regulations, safety & certification

Skill Development, Public awareness

Coordinated skilling programme, online portal

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Key Outcomes of Mission Envisaged by 2030

At least
5 MMT GH_2
annual Production

60-100 GW
Electrolyser capacity

125 GW RE Capacity for GH_2 Generation & associated Transmission network

₹ 1 lakh crore
Import Savings

50 MMT CO_2
Annual Emissions Averted

6 lakh
Jobs

₹ 8 lakh crores
Investment

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Mission Outlay

		Mission Components	Amount (₹ Crore)	Amount (₹ Crore)
Outlay recommended till 2029-30	i.	Strategic Interventions for Green Hydrogen Transition (SIGHT)	17,490	18,133
	ii.	Support for low-carbon Steel projects	455	
	iii.	Human Resource Development	35	
	iv.	Public Awareness and Outreach	70	
	v.	Programme Management	83	
Outlay recommended till 2025-26	vi.	Support for Shipping and ports projects	115	1,611
	vii.	Support for Mobility projects	496	
	viii.	GH_2 production technologies, storage, hubs, etc.	400	
	ix.	R&D Projects	400	
	x.	Testing Facilities, Standards & Regulations development	200	
	Total			**19,744**

Mission Components and Implementation

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Strategic Interventions for Green Hydrogen Transition (SIGHT)

Component I : Incentive Scheme for Electrolyser Manufacturing (₹ 4,440 crores)

- Scheme to be implemented by MNRE through Solar Energy Corporation of India (SECI) through competitive selection
- Bidders will be ranked in decreasing order of **Selection Parameter** = $\sum_{i=1}^{5}$ **Local Value Addition Factor X Performance Quotient**

- Base incentive starts at Rs. 4440/kW for 1-year and gradually tapers on an annual basis

Year of Sales	1	2	3	4	5
Base Incentive Available (Rs./kW)	4440	3700	2960	2220	1480

Incentive Payout for given Year = Electrolyser sales Volume (in kW) X Quoted Base Support Rate (in Rs./kW) X Performance Multiplier X Domestic Value Addition

*LVA Factor and Domestic Value Addition are based on Local Value Addition. Performance Quotient and Performance Multiplier are based on Specific Energy Consumption.

Mode 1 has a capacity of 1500 MW which is divided into 2 Buckets.

- Bucket 1 maximum allotment capacity to a single bidder is 300 MW, minimum is 100 MW.
- Bucket 2 maximum allotment capacity to a single bidder is 300 MW.
- Bidders can bid for either or both Buckets, Bucket 1 will be decided first

Bucket 1: Electrolyser manufacturing capacity based on any stack technology	Bucket 2: Electrolyser manufacturing capacity based on indigenously developed stack technology.
1200 MW	300 MW

Strategic Interventions for Green Hydrogen Transition (SIGHT)

Component II : Incentive Scheme for Green Hydrogen Production (₹ 13,050 crores)

- Scheme to be implemented by MNRE through Solar Energy Corporation of India (SECI) through competitive selection
- Incentives capped at ₹50/kg for I-year, ₹40/kg during II-year, and ₹30/kg during III-year
- Emission intensity as per National Green Hydrogen Standard (0.1765 kg equivalent GH_2 per kg of GNH_3)*

Total Capacities available for Tranche 1 (450,000 MT/annum)	Technology Agnostic Pathways (B1)	Biomass Based Pathways (B2)
	410,000 MT/annum	40,000 MT/annum
Minimum Bid Size	*90,000 MT/annum*	*10,000 MT/annum*

Incentive Payout for a given Year = Incentive quoted for that year (in Rs./kg) X Produced/Allocated Capacity**

- ❑ **Mode I**: Bidding on least incentive demanded over the 3-year period, through a competitive bidding process (**currently proposed**)
- ❑ Mode II: Designated agency (SECI) to float bids for procurement through aggregated demand of GH2 and derivatives through competitive selection process

Pilot Projects

- **Pilot project design and objectives** based on sector
- **Technology validation** and identification of **regulatory requirements**
- **Estimation of CFA based** on additional costs related to Green hydrogen adoption

Industry

- DRI Steel
- Industrial Process Heating

Mobility

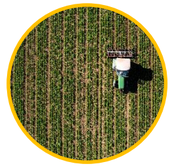
- HFCEV Vehicles
- Re-fueling Stations

Maritime

- H2 Propulsion
- Port Re-fueling Infra

Infrastructure

- Hydrogen Hubs
- Storage and Transportation



Green H_2 from biomass

- Agri residue, MSW, Sewage to Hydrogen

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Research and Development

Detailed R&D roadmap under development with a key focus on end-product development in partnership with academia & industry across the globe

Mission Mode Projects - 2022-2027

- Modular electrolysers, Type III/ Type IV compressed hydrogen tanks and PEM fuel cells, to increase operational efficiencies
- Biomass based hydrogen generation scale-up for commercial applications

Grand Challenge Projects - 2022-2030

- Critical electrolyser and fuel cell components like MEA, electrocatalysts, CCM, bipolar plates
- Upscale domestic manufacturing capabilities, improve efficiencies and drive down costs

Blue Sky Projects- 2022-2035

- 3rd gen electrocatalysts, reversible SOEC & SOFC, seawater electrolysis, thermo-catalytic pyrolysis, plasma pyrolysis, high entropy alloys for reversible H2 storage, etc.

Research and Development strategy under the Mission to support research, innovation and collaboration with the aim to make green hydrogen production, storage, transportation, and utilization affordable, and to enhance the efficiency, safety and reliability of the relevant systems and processes.

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Regulations Codes & Standards for Hydrogen Adoption

Hydrogen-Value Chain

Generation	Conditioning	Storage/Distribution	Application	End User
Green Hydrogen Standard	Liquefaction	Pipelines	Industrial Feedstock	Industries
	Compression	Road/Rail/Ships	Power Energy	Transport
		Physical Storage	Industrial Energy	Power
		Refueling stations	Transportation Fuel	

- Hydrogen Safety & Standards
- Harmonized Certification Frameworks
- Policy and Regulation Framework
- International Standards and Norms

MNRE has constituted a working group that consist of consists 3 sub-groups with representatives from stakeholder ministries, industry, and institutions for development of Regulations, Codes and Standards (RCS) framework for Green Hydrogen

Sub-Group-I	Sub-Group-II	Sub-Group-III
Hydrogen production and use	**Storage and Transportation of Hydrogen**	**Hydrogen-fuelled mobility applications**

Proposed Standard for India

"Green Hydrogen" shall mean *Hydrogen Produced using Renewable Energy, including, but not limited to, production through:*

a) Electrolysis

b) Conversion of biomass.

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On-Going Implementation of NGHM

Governance Framework: **Empowered Group, Advisory Group and Mission Secretariat** notified

Concept Notes on **SIGHT programme** formulated

Framework of **Standards and Regulations** proposed

Definition of Green Hydrogen proposed

Policy actions for reduction of RE cost initiated by **MNRE, MoP and State Governments**

A committee of experts is framing the **basis report for R&D roadmap**

State Level Policy Actions (1/3)

Uttar Pradesh – Draft Green Hydrogen Policy

- 100% exemption from payment of land tax, land use conversion charges, stamp duty,
- 50% exemption from industrial water consumption charges.
- 30% one-time grant support for technology acquisition subject to a max ₹ 5 crores
- 100% reimbursement of SGST, cross-subsidy surcharge, distribution charges
- 50% exemption from wheeling charges, intra-state transmission charges
- Additional subsidy of **INR 3500 per tonne** for green urea produced in the state beyond the 10 percent blending share in total production

Rajasthan (Draft Green Hydrogen Policy)

- Exemption from open access charges, wheeling charges, transfer charges, electricity duty, banking charges for 14 years
- 20% capital subsidy, for first 5 units/ companies investing more than ₹ 50 Crores, max subsidy ₹ 50 crore
- One-time reimbursement of **50%** of the cost incurred to acquire advanced technology, Maximum ₹ **2 Crores**.
- Investment Subsidy of **75%** of State tax due and deposited, for seven years.
- **100%** exemption from payment of Electricity Duty, Land Tax, Market Fee (Mandi Fee) for seven years
- **100%** exemption on Stamp Duty, conversion charges

State Level Policy Actions (2/3)

Madhya Pradesh – Renewable Energy Policy

- For electrolyser manufacturing, with investments:
- **Greater than or equal to Rs. 50 crores** will be eligible for special incentives embarked for the RE equipment manufacturing sector under the industrial promotion policy.

Tamil Nadu (Industrial policy)

- Special incentives for sunrise sectors
  - Additional capital subsidy of up to 7.5% of EFA for sunrise sector projects opting flexible capital subsidy.
  - 10% and 50% concessional rates for land allotment
  - 100% stamp duty exemption
  - Up to Rs. 1 crore subsidy on national and international certification charges.
  - Up to Rs. 1 crore reimbursement for intellectual property created by the project.
  - Interest Subvention up to f 5% as a rebate in the interest rate for financing the project for 6 years
  - Electricity tax exemption for 5 years and green industry incentives of up to Rs. 1 cr.
  - SGST refund on capital goods.

State Level Policy Actions (3/3)

Odisha (RE policy, Industrial Policy)

- Two Green Hydrogen / Green Ammonia hubs to be developed
  - Reimbursement of INR 3.00 per unit for power purchased & consumed from local DISCOMs for 20 years
  - Renewable energy consumed for manufacturing of green hydrogen & green –
    - Cross subsidy surcharge, additional surcharges & state transmission charges will be exempted for 20 years
    - 100% exemption from payment of Electricity Duty for 20 years from the date of commercial production.
  - 100% exemption from Stamp Duty.
  - Reimbursement of 100% of net SGST paid, overall limited to 200% of the cost of plant & machinery.
  - Reimbursement of 100% of the employer's contribution towards ESI & EPF Scheme for a period of 7 years

Gujarat (Aatmanirbhar Gujarat Scheme for large industries)

- Interest subsidy @ 7% for 8-10 years (cap 1% of investment)
  - 80-100% Net SGST reimbursement for 10 yrs (cap 8% of investment)
  - EPF reimbursement – 10 years for new employees
  - Electricity duty exemption

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WRI Research

Identification and Assessment of Potential Hydrogen Hubs

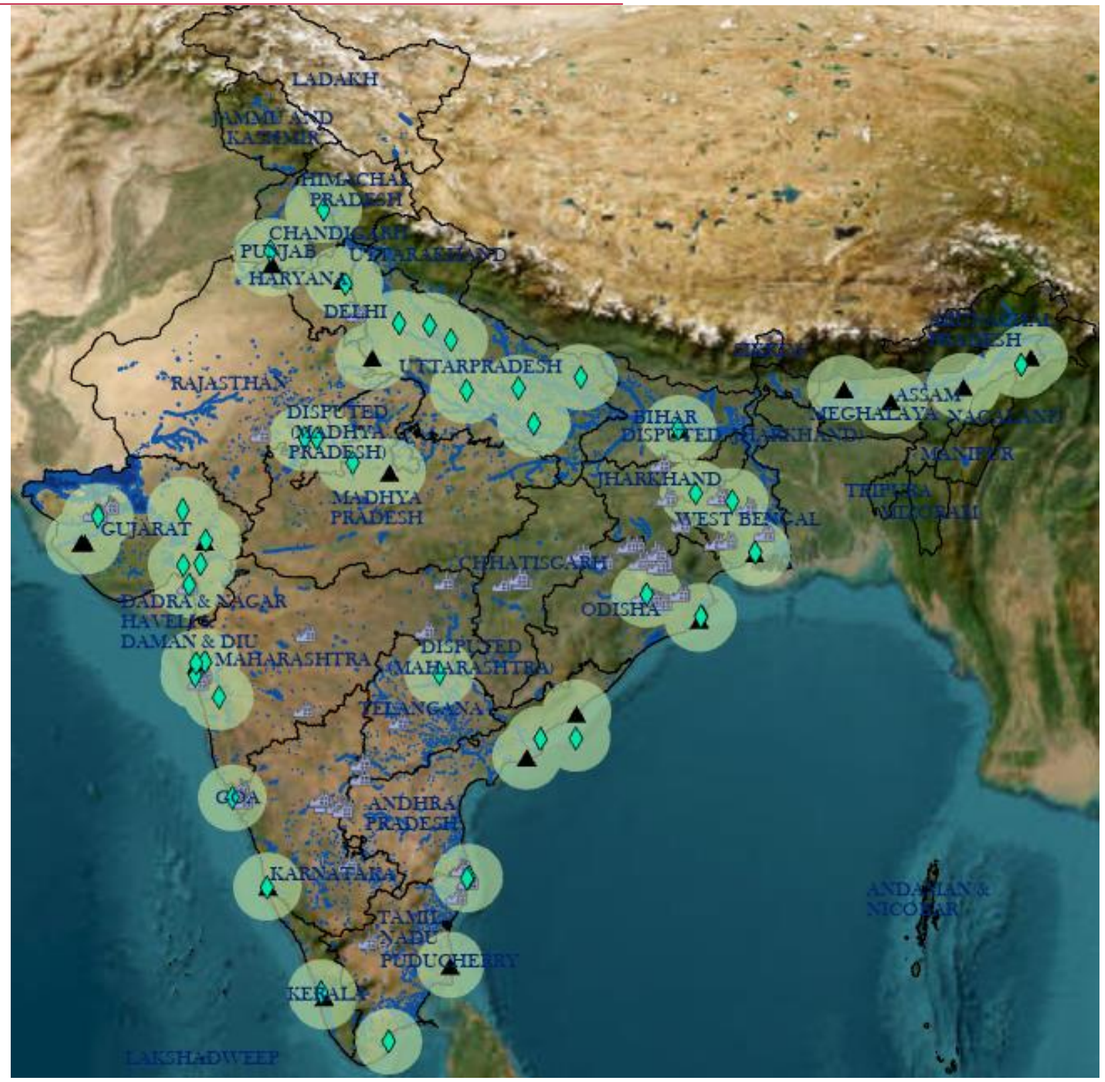
Stage 1
Identifying the potential consumption sites

Stage 2
Analyzing based on resource availability, infrastructure requirements and demand

- India's hydrogen consumption ~ 5 MMT annually
- 99% used in petroleum refining and ammonia production

➢ Spatial data for major hydrogen consumers in India:

- Oil Refineries (▲)
- Fertilizer plants (◆)



Hydrogen Production from Biomass

ONGOING/COMPLETED WORK

- ❑ Biomass residue availability study & applications of surplus residue/sewage/MSW for various bioenergy purposes
- ❑ Supply chain assessment & bottleneck study
- ❑ Hydrogen production potential study from different biomass production technology
- ❑ Literature review of various technologies to understand the biomass to hydrogen production routes
- ❑ Stakeholder consultation with multiple industry players & academicians

National Green Hydrogen Mission identified biomass as the potential pathway for the production of green hydrogen & aims to initiate focused pilot programs.

Future Activities

- ❑ Working paper on the technical feasibility assessment of various hydrogen production routes from biomass

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Supply Chains and Critical Mineral Assessment

National Green Hydrogen Mission provides subsidy to electrolysers as the potential pathway for the production of green hydrogen

Future Activities

- ❑ Working paper on the critical minerals supply chain and demand assessment for electrolysis production routes for hydrogen

ONGOING/COMPLETED WORK

- ❑ Critical minerals assessment for electrolysers
- ❑ Supply chain assessment & bottleneck study
- ❑ Hydrogen production potential demand study for critical minerals from different production technology
- ❑ Literature review to understand the electrolysis hydrogen production routes

Thank You