

SESSION 8

HYDROGEN CELL



**MUKTIKAM
PHUKAN**



Hydrogen Transportation Through Pipelines & Blending with Natural Gas

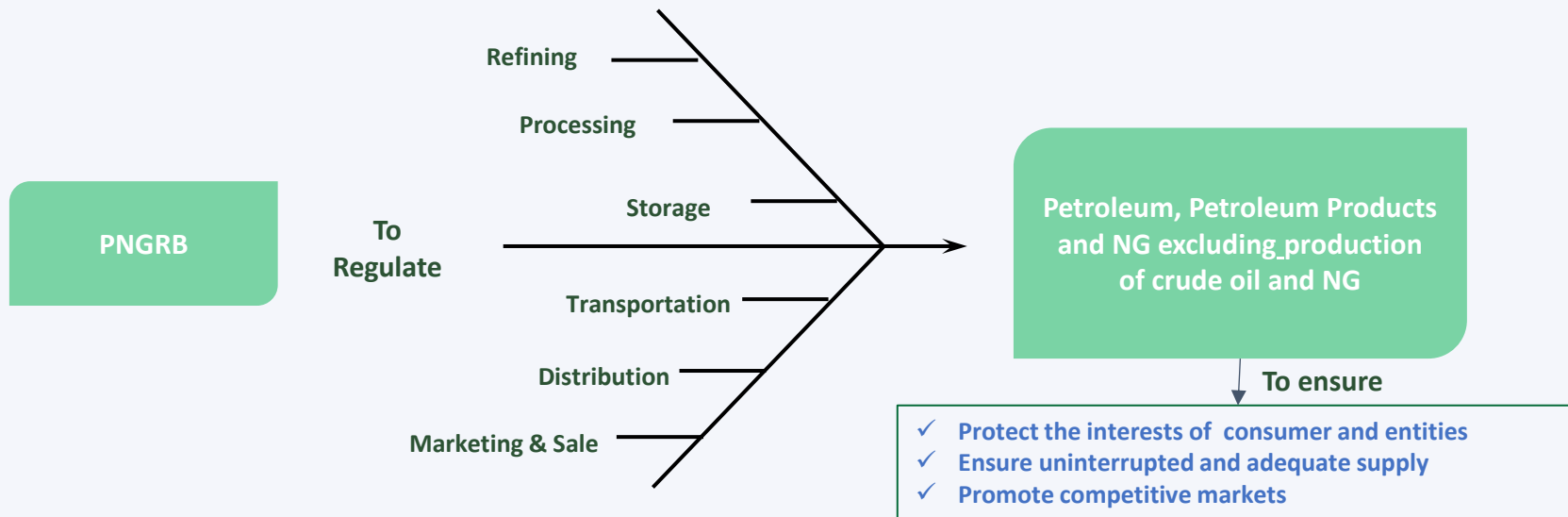
Shri Muktikam Phukan

Director (Coordination) & Officer I/C – Hydrogen Cell
Petroleum and Natural Gas Regulatory Board (PNGRB)

About PNGRB



Petroleum and Natural Gas Regulatory Board (PNGRB) was established by an Act of Parliament in 2006 by Government of India with an objective to regulate the refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas so as to protect the interests of consumers and entities engaged in specified related activities and to ensure uninterrupted and adequate supply of petroleum, petroleum products and natural gas in all parts of the country and to promote competitive markets.



PNGRB'S HYDROGEN JOURNEY



NGHM Clause 6.4: MoPNG will facilitate uptake of Green Hydrogen in refineries and City Gas Distribution through both Public Sector Entities and private sector. MoPNG will also enable development and facilitation of regulations through the **Petroleum and Natural Gas Regulatory Board (PNGRB)**. New refineries and CGD projects will be planned and designed to be compatible with maximum possible Green Hydrogen deployment.

Hydrogen Blending Pilots

5 pilots across MP, Gujarat, Assam & UP (2–8% blending). Testing MDPE & steel pipelines, stratification, metering, leakage & consumer-end performance.

National Hydrogen Roadmap

India's first Hydrogen Transportation Roadmap with phased strategy (2025–2033) for blending and future pure hydrogen transportation.

Statutory Amendments

PNGRB has proposed amendments to the PNGRB Act, 2006 to explicitly include hydrogen transportation through pipelines & blending within its regulatory mandate for statutory clarity.

Dedicated Hydrogen Cell

Established within PNGRB to lead regulatory development, standards alignment & coordination with Ministries, PSUs, and international organizations.

Collaborations

MoU with DVGW (Germany); collaborations with SGN and IGEM, visits to DNV Spadeadam (UK); engagement with IITs, GERMI-Gujarat & IOCL.

National Hydrogen Safety Panel

PNGRB representative serves on the National Hydrogen Safety Panel (NHSP) under NGHM.

What PNGRB Knows — And Where It Can Go

Tariff & Access Regulations

Tariff setting, access codes, capacity management, GTA standardization

Registration, Licensing & Authorization

CGD bids, pipeline authorizations, competitive bidding frameworks

Technical & Safety Regulations

Technical standards, safety audits, ERDMP, incident management

Consumer Protection

Grievance redressal, quality assurance, ombudsman frameworks

Data & Monitoring

NHIMS, project tracking, compliance dashboards, geo-tagging

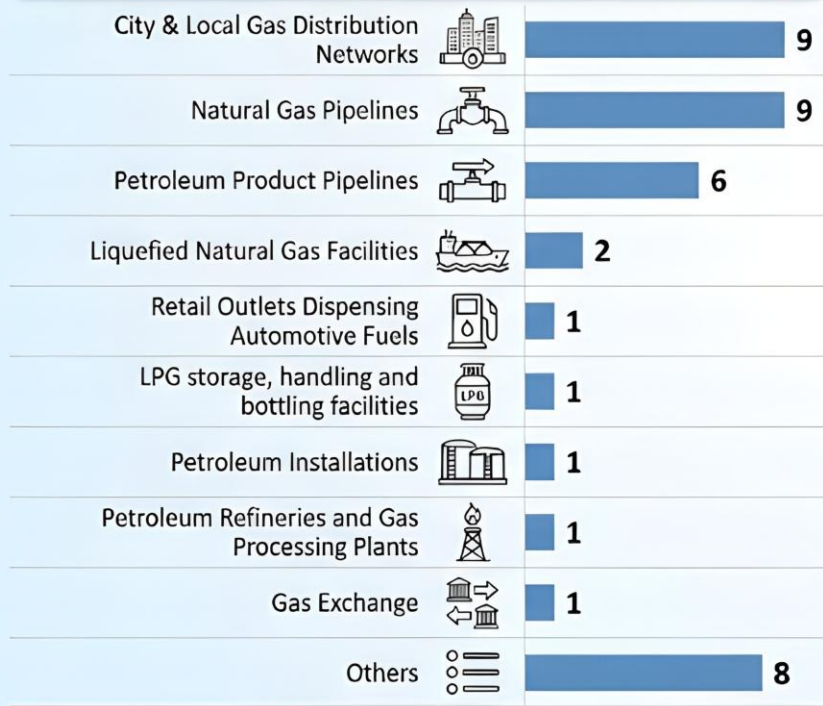
International Collaborations

MoUs with API, ASME, DVGW, SGN, IGEM, — global benchmarking

KEY INSIGHT: These capabilities apply across sectors. Whether it is gas, hydrogen, CBG, water or coal gas, all are transported through pipelines. Pipelines are central to energy transport, so the core regulatory approach remains broadly similar.

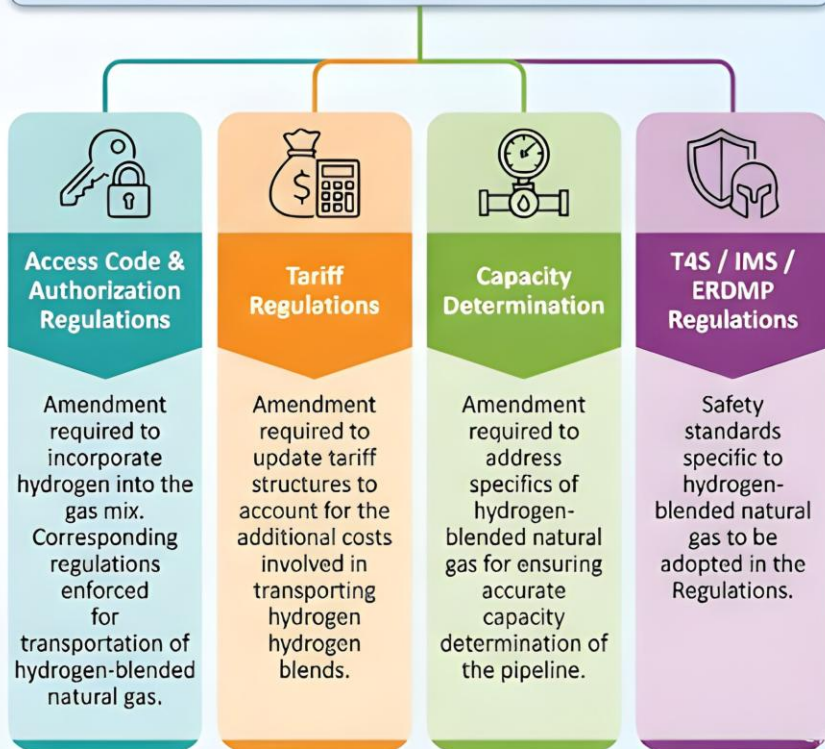
Transitioning to Hydrogen: Regulatory Landscape & Required Amendments

Current Regulatory Framework (39 Total)



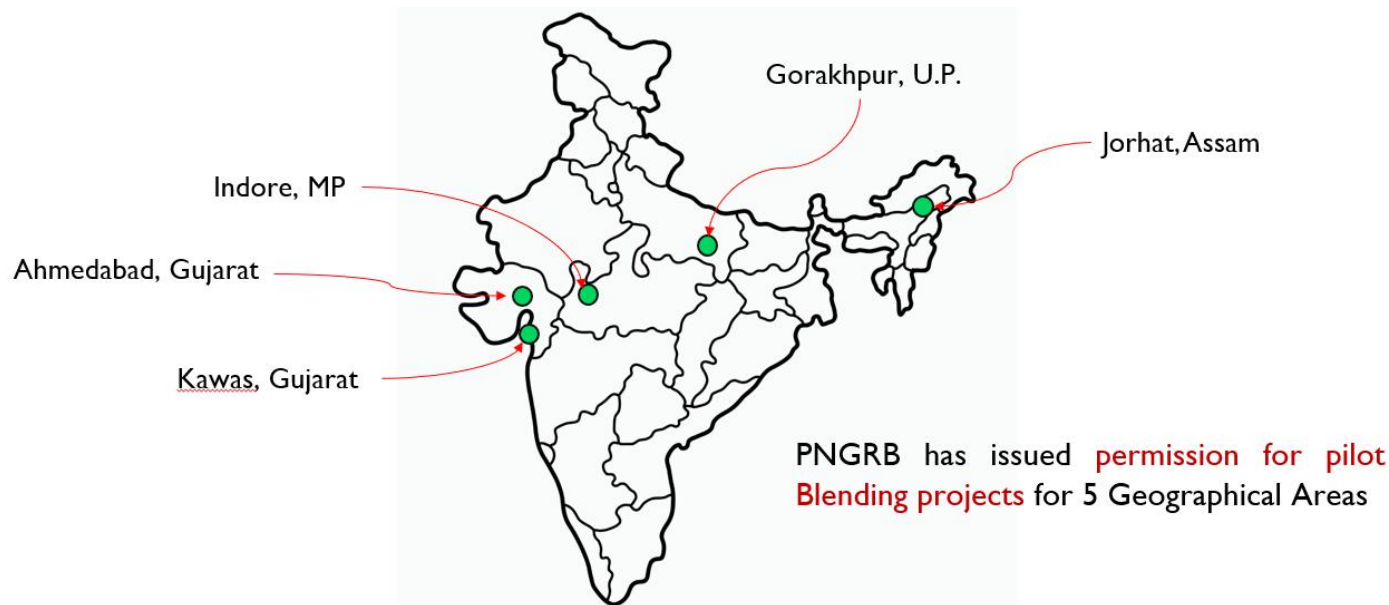
Total Regulations: 39

Amendments for Hydrogen Transportation & Blending



India's First Hydrogen Blending Pilots

PNGRB-approved hydrogen blending pilots across 5 projects in 4 states — generating India-specific pipeline blending data



SOME KEY PARAMETERS UNDER ASSESSMENT

MDPE & Steel Pipeline Behaviour	Stratification Characteristics	Leakage Profiles	Metering Impacts	Consumer-End Performance
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Initial findings will form technical inputs for drafting India's hydrogen blending regulations

India's First Hydrogen Blending Pilots



Pilot Projects

Entity	Gujarat Gas Limited– NTPC, Kawas	Avantika Gas Limited, Indore GA	Assam Gas Company, Jorhat Assam	Adani Total Gas Limited – Ahmedabad	Torrent Gas Limited – Gorakhpur
Pilot Study Area	NTPC Kawas Township	Indore, MP (Blending in Entire Charge Area)	Household in Base Pumping Station of M/s OIL in Jorhat, Assam	Domestic Households and commercial customers in Shantigram area of Ahmedabad	Blending in entire CGD network of Gorakhpur GA
Customers Served	Domestic PNG (within the township)	Domestic PNG, Industrial, Commercial	Domestic PNG (within the township)	Domestic PNG, Commercial	Domestic PNG, Industrial, Commercial & CNG
Injection	Injection into MDPE Pipeline	Injection into MDPE PNG network at CGS Sanwer Road, Indore	Injection into MDPE Pipeline	Injection into MDPE pipeline	Injection in Steel Pipeline at CGS
Blending Percentage	8% (v/v) (Reduced to 5%)	5% (v/v)	2% (v/v)	5% (v/v)	2% (v/v)
Proposal Clearance	03.11.2023	23.10.2022	31.03.2023	30.05.2024	29.11.2024
Current Status	Blending Stopped by PNGRB; 3rd party assessment in progress	Blending Stopped by PNGRB; 3rd party assessment under evaluation	Blending in progress; To be stopped in May 2026 end and 3rd party assessment to be taken up	Blending Stopped by PNGRB; 3rd party assessment in progress	Blending in progress; To be stopped in August 2026 end and 3rd party assessment to be taken up

Pathways Precursor Study → PNGRB Roadmap



Precursor study — key messages

- **Blending envelope: up to 2% hydrogen blending is feasible** with minimal adjustments; up to 10% is technically possible but requires case-specific pipeline and network assessments; >10% entails major system changes.
- **Strategic implication:** pure hydrogen pipelines may be more cost-effective than implementing high-percentage blending (>10%).
- **End-user constraints:** CNG vehicle tanks are limited to 2% H₂; higher blends require debinding near CNG stations (≈₹5.2 Cr per station). Urea plants also require debinding (>2%), with cost impacts (≈₹3.2/kg urea).
- **Study structured into five tasks:** demand–supply mapping, technical assessment, commercial assessment, regulatory assessment, and a roadmap.
- **Recommended 12-month actions:** initiate PNGRB Act modifications to cover H₂ transport/blending and allied infrastructure; commence detailed technical assessments and standards alignment.



→ Pathways for Transmission of Hydrogen in Natural Gas Pipelines and City Gas Distribution Network

Final Report

19 June 2025

Submitted by:
ICF Consulting India Pvt. Ltd.



PNGRB's Roadmap on H2 Transportation through Pipelines and Blending with Natural Gas



India's First Comprehensive Hydrogen Transportation Roadmap

- ▶ PNGRB has developed India's first Roadmap on H2 Transportation through Pipelines and Blending with Natural Gas
- ▶ Provides phased strategy for hydrogen blending and future pure hydrogen transmission
- ▶ Readiness Assessment Module: scientific evaluation of pipeline segments for initial blending — material compatibility, weld performance, corrosion, operational conditions
- ▶ Recommends establishment of a National Hydrogen Testbed as the backbone for India-specific evidence generation
- ▶ Phased approach: Phase I (2025–2028) & Phase II (2029–2033)

PHASE I | 2025 – 2028

- ✓ Operationalise Hydrogen Cell
- ✓ Commission National Hydrogen Test Bed
- ✓ Notify foundational blending standards
- ✓ Capacity building & pilot plant learnings
- ✓ Initiate controlled blending pilots

PHASE II | 2029 – 2033

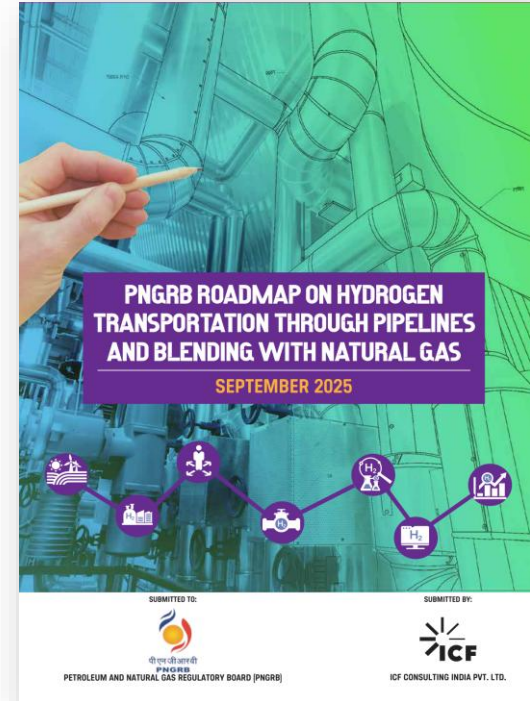
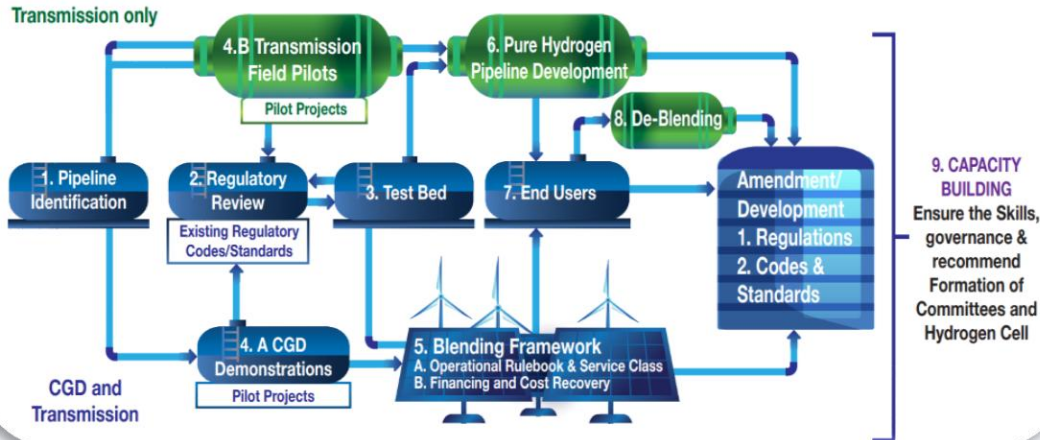
- ✓ Scale blending operations network-wide
- ✓ Expand hydrogen integration to new corridors
- ✓ Update standards based on cumulative evidence
- ✓ Progress towards dedicated hydrogen pipelines
- ✓ Full regulatory framework for 100% H₂ transport

PNGRB's Roadmap on H2 Transportation through Pipelines and Blending with Natural Gas



Roadmap Alignment

- The roadmap provides a phased, module-based pathway for hydrogen blending and long-term pure H₂ transport.
- It provides various recommendations that are to be executed within a timeline.



National Hydrogen Test Bed



The Scientific Backbone for India-Specific Evidence Generation

Full-Scale Test Loops

High-pressure transmission &
low-pressure CGD/MDPE systems

Material Testing

H₂ embrittlement, fatigue,
elastomer & weld compatibility

Component Assessment

Valves, meters, compressors
under H₂ service

Operational Safety

Pressure cycling, leakage
characteristics, stratification

SCADA Monitoring

Real-time instrumented
monitoring & flow evaluation

OEM Certification

Standards validation for
manufacturer certifications

TERMS OF REFERENCE

A. R&D framework

Define core research themes for material compatibility, blending ratios, debblending methods and challenges such as Hydrogen (H₂) embrittlement and sensor integration.

Prioritize indigenous solutions tailored to Indian infrastructure, safety, and cost conditions.

B. Testbeds & pilot projects

Propose and monitor pilot projects/testbeds to refine technical solutions for NGPL and CGD.

C. Regulatory standards & protocols

Drafting Indian regulatory standards and safety protocols for hydrogen transportation and blending.

Integrate global literature with outcomes from Indian R&D and pilot studies.

D. Safety assessment

Examine safety risks across the hydrogen value chain (production, transport, blending, end-use). Develop India-specific safety codes and protocols, especially for high-pressure blending and residential use.

Review global and academic safety literature to ensure thorough risk mitigation.

KEY DELIVERABLES



India-Specific Blending Guidance

Technical guidance document codifying optimal blend levels, material compatibility limits, and operational parameters.



Safety Protocols & Standards

SAC-validated hydrogen safety protocols for pipeline operations, emergency response, and compliance frameworks.



Testbed Evaluation

Assessment of National Testbed design with recommendations for loop configuration, instrumentation, and test methodology.



Pilot Review Reports

Structured technical assessments of GAIL (NGPL) & IGL (CGD) testbed pilots with findings and recommendations.



Regulatory Recommendations

Evidence-based inputs for PNGRB regulatory amendments, operational rulebooks, and tariff frameworks.

International Collaborations (EU-UK Focus)



PNGRB × IGM (UK)

Effective date: Apr 2025 • Focus: standards knowledge + training + certification ecosystem

- Build knowledge on standards/regulations for Natural Gas/CGD, biomethane and hydrogen
- Leverage IGM technical standards expertise to strengthen standards & certification in India (incl. professional development/training)

PNGRB × SGN (UK)

Effective date: Aug 2025 • Focus: hydrogen blending pilots + integrity management learning

- Share knowledge and technological advancements in the natural gas sector
- Knowledge exchange on hydrogen and hydrogen blending with natural gas
- Explore joint research/pilot projects and pathways for hydrogen adoption in India

PNGRB × DVGW (Germany)

MoU (non-binding) • Exchanged: 12 Jan 2026 • Focus: hydrogen integration in NG infrastructure

- Access to DVGW technical rules / test principles (with translation support) for India-ready standardisation
- Hydrogen Readiness Testing Scheme (HRTS): materials + component/loop tests + field pilots
- Hydrogen-ready certification + supporting database of suitable components/processes
- Network simulation tools for blends (up to ~20% initially) with roadmap towards 100% hydrogen
- Exchange on odorisation, leak detection & safety methodologies; technical exchanges/visits and anonymised data sharing



Safety in Hydrogen Pipeline Transportation & Blending

Key safety considerations for pipeline-based hydrogen transmission and blending with natural gas



Hydrogen Embrittlement

H₂ causes embrittlement in high-strength steels — material selection, fracture mechanics assessment (ASME B31.12) & pressure management are critical safety measures

Leak Detection

H₂ is odourless, colourless, and highly buoyant — requires advanced sensor arrays, SCADA-integrated leak monitoring, and lower explosive limit (LEL) alarms at critical points

Odourisation Challenges

Conventional mercaptan-based odorants interfere with fuel cells — novel odorant development or alternative detection strategies required for H₂ blended networks

Blending Ratio Controls

Maintaining safe H₂ blend concentrations requires precision injection systems, flow metering, and real-time compositional monitoring across the network

Pipeline Integrity

Regular inspection regimes, in-line inspection (ILI) tool compatibility, and modified cathodic protection protocols are essential for H₂-service pipelines

Emergency Response

Dedicated H₂ emergency protocols: higher flammability range (4–75%), rapid dispersion behaviour, and specialised ignition risk management frameworks



Safety is Non-Negotiable: The Hindenburg Lesson

A single incident can derail decades of progress — public trust, once lost, is very hard to rebuild



The Hindenburg Disaster May 6, 1937

36 lives lost: in 34 seconds as the hydrogen airship erupted in flames

Radio broadcast: live — "Oh, the humanity!" heard by millions worldwide

Hydrogen aviation: ended overnight; entire industry scrapped due to public fear

34 years to recover: it took until Apollo-era to rebuild public confidence in H₂

Root cause was NOT H₂: incendiary coating on the skin ignited first — yet H₂ bore all blame

Why This Matters for India's H₂ Mission

Public perception is fragile: One visible incident near homes or CNG stations could mobilise mass opposition

Media amplification: Social media ensures any accident becomes a global headline in minutes

Investor confidence: ₹19,744 Cr NGHM investment is contingent on demonstrable safety frameworks

Niti Aayog parallel: India's own planners have flagged that consumer apprehension can derail H₂ adoption

Safety = Enabler: Robust standards, regulations, testing & pilot data build the evidence base needed to proceed



"Safety is not a constraint on ambition — it is the foundation upon which ambition can be built."



Thank You

Shri Muktikam Phukan

Director (Coordination) & Officer I/C – Hydrogen Cell

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For Any Queries

Email: e-coordination@pngrb.gov.in