A Comprehensive Study on Green Hydrogen Market & Trading

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

H2Uppp

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IGX INDIAN GAS EXCHANGE an IEX venture

Study by:

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The study incorporated inputs from 8-10 project developers, 10+ industrial off-takers, 5+ midstream and logistics partners, and 5+ international stakeholders and commodity exchanges. These consultations provided valuable insights into supply-side development, demand requirements, logistics and infrastructure and global best practices across the green hydrogen value chain.

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The International Hydrogen Ramp-up Programme (H2Uppp) of the German Federal Ministry for Economic Affairs and Energy (BMWE) promotes projects and market development for green hydrogen in selected developing and emerging countries as part of the National Hydrogen Strategy.

New Delhi, July 2026

Stakeholder Feedback Questionnaire - Comprehensive Study for Developing India's Green Hydrogen Market & Trading Framework

PURPOSE

A comprehensive study has been conducted for developing India's green hydrogen market and trading framework. This survey is being conducted to gather stakeholder feedback on the proposed framework, which would help in:

- **Validating the findings and recommendations of the study**
- **Shaping a robust, inclusive, and actionable framework that reflects ground realities and industry perspectives**

INSTRUCTIONS

To participate,

1. Open the URL provided or scan the QR code.
2. Enter your name, company name, designation, and email address.
3. Answer the multiple-choice questions based on your experience and understanding of the project

Click here to participate

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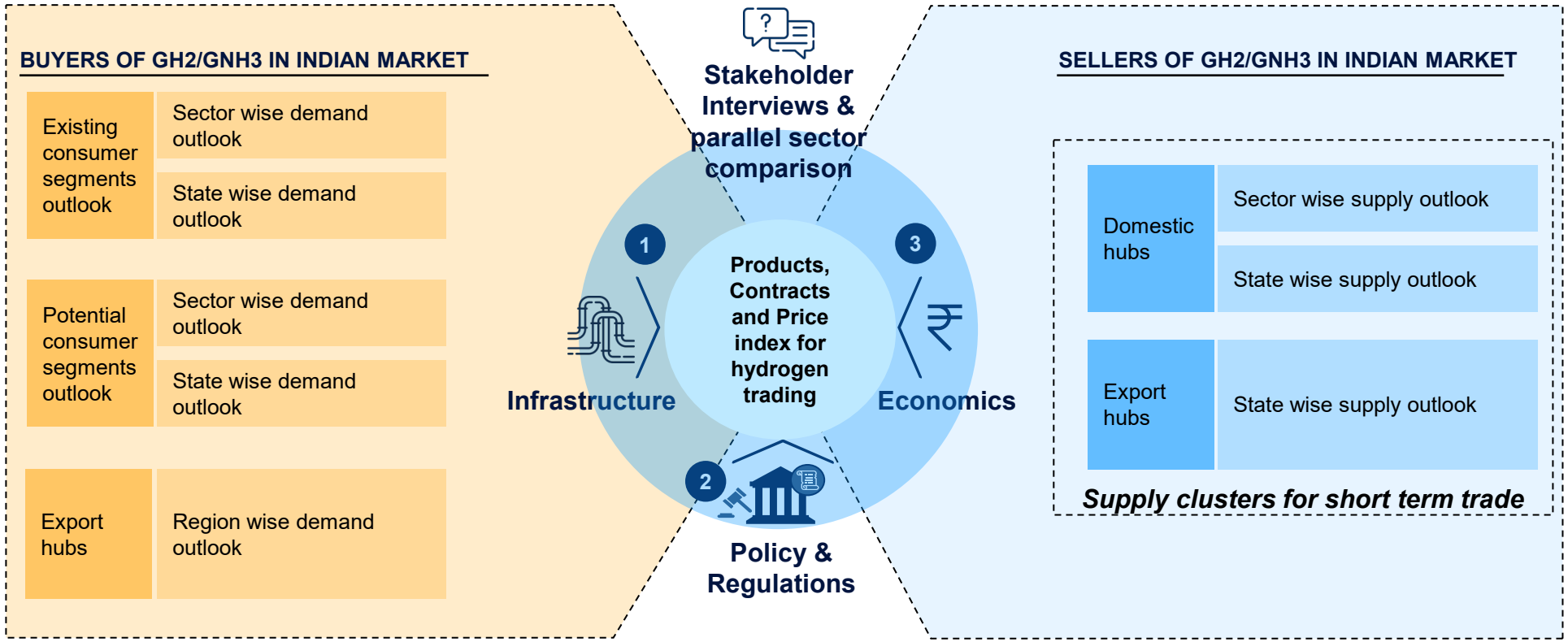
Reading guide: Sectional overview

Objective

The objective of this report is to develop a comprehensive roadmap for establishing a robust **Green Hydrogen Market and Trading Framework in India**, covering key components across the hydrogen value chain including production, storage, transportation, demand, and trading mechanisms

Section	Objective
1 **Executive Summary**	Section 1 presents a comprehensive overview of the trading potential for green hydrogen and its derivatives, integrating analysis across the demand and supply ecosystem. The section further outlines indicative contract specifications suitable for exchange-based trading, proposes a methodology for price index development, and introduces a high-level roadmap with key milestones.
2 **Demand (existing and outlook)**	Section 2 provides a detailed assessment of the demand landscape. It examines both existing consumption patterns and future demand outlook across key sectors such as refineries, fertilizers, chemicals, mobility, and power. The section also distinguishes between domestic demand drivers and export-oriented opportunities
3 **Supply (existing and outlook)**	Section 3 evaluates the supply potential of green hydrogen in India, considering factors such as renewable energy availability, production economics etc. It further assesses infrastructure-related constraints, including storage, transportation, and distribution challenges, and identifies key bottlenecks that may impact scalability and timely market development.
4 **Trading model**	Section 4 outlines the proposed trading model for green hydrogen and its derivatives. It elaborates on key contract design elements, such as contract types, tenure, delivery mechanisms, quality specifications, and settlement processes, to ensure alignment with industry requirements and facilitate efficient market functioning.
5 **Price Index**	Section 5 details the methodology for developing a price index. It covers the conceptual framework for index construction, including identification of relevant price components, data sources, calculation approaches, and frequency of publication. The section also discusses considerations for ensuring transparency, reliability, and market acceptance of the index.
6 **Roadmap for development of Trading platform**	Section 6 presents a structured roadmap for the development and launch of the trading platform, outlining key activities across regulatory alignment, product design, infrastructure readiness, participant onboarding, and platform deployment. It defines clear timelines and milestones, providing a phased approach to implementation that reflects market maturity and ecosystem readiness
7 **Summary of stakeholder consultations**	Section 7 summarizes the findings from stakeholder consultations conducted across the hydrogen value chain, including producers, consumers, logistics providers, policymakers, and technology players.
8 **Global case studies**	Section 8 provides a set of global case studies and benchmarking analysis, examining established and emerging hydrogen markets and trading frameworks.

Framework | Green hydrogen and derivatives trading market setup



Global case examples of short term trading and price indices

Note: Definition

Definition (1/5)

Term	Definition
Anchor Sector Demand	Demand originating from large, established industries such as refineries and urea-based fertilizer plants that operate continuously and are tied to long-term bilateral contracts (10–15 years) for hydrogen supply.
Auction Mechanism (Double-Sided Uniform Price)	A price discovery mechanism where both buyers and sellers submit bids and offers simultaneously; a single clearing price is determined for all matched transactions. Used in IGX-style trading for green hydrogen/ammonia derivatives.
Base Case	A conservative scenario anticipating slower adoption compared to the global trend. It represents a cautious outlook, outlining small yet achievable cases amid expectations of lagging adoptions, serving as a realistic baseline for forecasting while considering potential challenges.
Carbon Credit Trading Scheme (CCTS)	A government-mandated scheme notified by the Central Government of India in June 2023 for tracking and trading carbon credits. It enforces annual emission reduction targets across sectors such as refining, fertilizers, chemicals, iron & steel, and cement to steer demand toward green hydrogen.
Contract for Difference (CfD)	A financial contract used for price risk management, where the difference between a fixed strike price and the market price is settled in cash. Essential for de-risking early green hydrogen projects where developers need long-term offtake certainty.
Cost-Plus Price Index (Supply-Based)	A price index methodology where the benchmark price is computed from the sum of fixed OPEX + (electricity price + electricity tax + Guarantees of Origin) ÷ electrolyzer efficiency + water costs. Used for export and anchor sector green hydrogen/ammonia pricing.
Croyogenic transport	A hydrogen storage mechanism combining cryogenic cooling and high-pressure compression. Currently in advanced demonstration and early commercialization stages globally.
Demand Centre	A geographic area with significant and concentrated hydrogen or hydrogen-derivative consumption, forming the basis for trading hub location decisions. Four key demand centres are identified for India (domestic anchor, domestic fragmented, export anchor, export niche).
Direct Reduced Iron (DRI) / H2-DRI	A low-carbon iron-making process where hydrogen (rather than coal) reacts with iron ore to remove oxygen, producing sponge iron and water instead of CO_2. Hydrogen serves as the reducing agent enabling low-carbon steel production.

Definition (2/5)

Term	Definition
Electrolysis	The process of using electricity to split water molecules into hydrogen (H_2) and oxygen (O_2). When powered by renewable electricity, this process produces Green Hydrogen.
Emission Trading	The EU ETS is a market-based cap-and-trade system that sets a strictly diminishing limit on total industrial greenhouse gas emissions. Companies receive or purchase tradable carbon permits; cleaner firms profit by selling surplus allowances, while heavy polluters must buy more.
Energy Banking	An arrangement where surplus renewable energy generated is 'banked' with the electricity grid. The banked energy is then drawn back during periods of low renewable energy generation.
Export Hub	A strategic coastal location with port infrastructure designated for large-scale export of green hydrogen derivatives (green ammonia, green methanol). Key Indian export hubs include Deendayal Port (Kandla), V.O. Chidambaranar Port (Tuticorin), and Paradip Port.
Final Investment Decision (FID)	The point at which a company or project developer formally commits capital to proceed with a project, triggering engineering and construction. Only ~5% of India's announced GH2 capacity had reached FID as of 2025.
Forward Contract	A binding agreement between a buyer and seller to trade a commodity at a specified price at a future date. The preferred contract type for green and grey ammonia trading on the proposed Indian hydrogen exchange.
Front End Engineering Design (FEED)	Intermediate design phase following feasibility studies that defines project scope, selects technology (e.g., PEM vs. Alkaline electrolyzers), optimizes plant layout, and establishes firm cost estimates
Fuel Cell Electric Vehicle (FCEV)	A type of electric vehicle that uses a hydrogen fuel cell to generate electricity on board for powering an electric motor. Unlike ICE vehicles, FCEVs chemically react hydrogen with oxygen to produce electricity, water, and heat.
Gas Index of India (GIXI)	India's first nationwide natural gas price index, introduced by IGX in 2023, reflecting benchmark natural gas prices. Calculated as a volume-weighted average of all transactions on the exchange.

Definition (3/5)

Term	Definition
Green Ammonia (GNH3)	Ammonia produced using green hydrogen via the Haber-Bosch process, powered entirely by renewable electricity. Qualifies as green when the hydrogen used has non-biogenic GHG emissions not exceeding 2 kg CO_2 eq per kg of H_2 produced.
Green Hydrogen Certification Scheme of India	A government certification framework launched in 2025 to verify that hydrogen produced in India qualifies as green hydrogen under prescribed emission standards, including the issuance of Guarantees of Origin (GoO).
Green Methanol	Methanol produced using green hydrogen, via a process where H_2 reacts with CO_2 (via RWGS reactor) to produce methanol. Qualified under renewable fuel regulations for shipping and chemical sectors.
Green Hydrogen (GH2)	Hydrogen produced via electrolysis powered by 100% renewable energy (solar, wind), resulting in near-zero carbon emissions. India's NGHM targets 5 MMT of green hydrogen production by 2030.
Guarantees of Origin (GoO)	Certificates that verify and attest that a specific quantity of hydrogen or electricity was produced from renewable sources. Required for green hydrogen certification and traded separately on exchanges.
Haber-Bosch Process	The industrial chemical process by which hydrogen and nitrogen from air are combined under high pressure and temperature to produce ammonia (NH_3), the key building block for nitrogen fertilizers like urea.
LCOA	The total cost of producing one kg or tonne of ammonia over a plant's lifetime, including CAPEX (RE plant, electrolyzer, ASU, NH_3 plant), OPEX, water desalination, and hydrogen storage costs, expressed in INR/kg.
LCOE	The average net present cost of electricity generation over a power plant's lifetime, accounting for capital cost (CAPEX), operating cost (OPEX), financing costs, and capacity factor. Key input into LCOH calculation.
LCOH	The total cost of producing one kg of hydrogen over a project's lifetime, incorporating LCOE, electrolyzer CAPEX and OPEX, water costs, and grid charges. Current green hydrogen LCOH in India is approximately INR 350–400/kg.

Definition (4/5)

Term	Definition
National Green Hydrogen Mission (NGHM)	India's flagship policy framework targeting the production of 5 MMT of green hydrogen by 2030, supported by ₹9,400 crore in production incentives, ₹1,350 crore for electrolyzer manufacturing, and a goal to scale RE capacity to 500 GW by 2030.
Optimistic Case	Aggressive case refers to a scenario where expectations for adoptions are more optimistic and rapid compared to the base case. It represents a more ambitious outlook, projecting faster and larger-scale adoption of a technology but needs proactive involvement of all stakeholders to achieve the goal
PLI – Production Linked Incentive	A Government of India financial incentive scheme tied to incremental production. For green hydrogen: ₹9,400 crore for GH2 production, and ₹1,350 crore for electrolyzer manufacturing.
Price Discovery	The process by which the market price of a commodity is determined through the interaction of supply and demand, bids and offers, on a trading platform or exchange.
Price Index	A published benchmark price for green hydrogen or green ammonia, calculated using a defined methodology (cost-plus, market poll, or SECI tender prices). India's proposed index will publish in INR/kg and EUR/kg at cluster and national levels.
SMR – Steam Methane Reforming	The dominant industrial process for producing hydrogen by reacting natural gas (methane) with steam over a catalyst to produce a syngas mixture of H_2 and CO. Primary source of grey hydrogen.
Title Transfer Facility (TTF)	A virtual natural gas trading hub in the Netherlands that serves as Europe's benchmark gas price. It overtook the UK's NBP (National Balancing Point) as Europe's premier hub in 2018.
Liquid Organic Hydrogen Carriers (LOHC)	Chemical compounds (e.g., toluene, dibenzyltoluene) that can reversibly bind and release hydrogen, enabling safe transport and storage of hydrogen in liquid form at ambient conditions.
Viability Gap Funding (VGF)	Government financial support provided to bridge the gap between the cost of green hydrogen production and the price at which buyers can afford to purchase it, enabling otherwise unviable projects to proceed

Abbreviations (1/2)

ACV: Accredited Carbon verifier
ADBI: Asian Development Bank Institute
ANERT: Agency for New and Renewable Energy Research and Technology
AP: Andhra Pradesh
APAC: Asia-Pacific
ASU: Air Separation Unit
ATF: Aviation Turbine Fuel
AWE: Alkaline Water Electrolyser
BEE: Bureau of Energy Efficiency
BESS: Battery Energy Storage System
BOO: Build Own and Operate
BPCL: Bharat Petroleum Corporation Limited
CAPEX: Capital Expenditure
CI: Carbon Intensity
CCS: Carbon Capture and Storage
CCTS: Carbon Credit Trading Scheme
CEA: Central Electricity Authority
CEGH: Central European Gas Hub
CEE: Central and Eastern Europe
CfD: Contract for Difference
CGD: City Gas Distribution
CME: Chicago Mercantile Exchange / CME Group
CO2: Carbon Dioxide
CoE: Centre of Excellence
Cr: Crore (Indian unit, = 10 million)
CSS: Cross-Subsidy Surcharges
CUF: Capacity Utilisation Factor
DRI: Direct Reduced Iron
DST, India: Department of Science and Technology, India
DST, SA: Department of Science and Technology, South Africa
EEX: European Energy Exchange
EPC: Engineering, Procurement and Construction
ETS: Emissions Trading System
EU: European Union
EV: Electric Vehicles
EVE: Energy Agency of Basque
FCEV: Fuel Cell Electric Vehicle
FCI: Fixed Capital Investment
FDRE: Fixed-price Direct Renewable Energy (auction)
FEED: Front End Engineering Design
FID: Final Investment Decision
GAIL: Gas Authority of India Limited
G-DAM: Green Day-Ahead Market
GH2: Green Hydrogen
GHCI: Green Hydrogen Certificate Framework
GHG: Green House Gases
GJ: Gujarat
GIXI: Gas Index of India (IGX benchmark price index)
GNH3: Gaseous Ammonia
GoI: Government of India
GOO: Guarantees of Origin (renewable energy certificates)
GSPA: Gas Supply and Purchase Agreement
GW: Giga-Watt
H2: Hydrogen (molecular)
H2-DRI: Hydrogen-based Direct Reduced Iron
HHV: Higher Heating Value
HMM: Hyundai Merchant Marine
HPHT: High Pressure High Temperature (gas)
HR: Haryana
HVIC: Hydrogen Valley Innovation Cluster
HYDRIX: EEX Hydrogen Price Index (bid-ask average index)
HYCLICX: HyXchange Hydrogen Linked Cost Index (Netherlands)
ICE: Intercontinental Exchange
IEX: Indian Energy Exchange
IFSCA: International Financial Services Centres Authority
IGX: Indian Gas Exchange
IIBX: India International Bullion Exchange
IIT: Indian Institute of Technology
INR: Indian National Rupee

Abbreviations (2/2)

INR: Indian National Rupee
IOCL: Indian Oil Corporation Limited
IPIECA: International Petroleum Industry Environmental Conservation Association
IPCC: Intergovernmental Panel on Climate Change
IPR: Industrial Policy Resolution (Odisha)
ISA: International Solar Alliance
ISCC: International Sustainability and Carbon Certificate (EU)
ISTS: Inter-State Transmission System
JOGMEC: Japan Organization for Metals and Energy Security
JRC: Joint Research Centre
KA: Karnataka
KEEI: Korean Energy Economics Institute
KL: Kerala
KPI: Key Performance Indicator
KTPA: Kilo Tonnes Per Annum
LDC: Long-Duration Contract
LHV: Lower Heating Value
LNG: Liquefied Natural Gas
LCOA: Levelized Cost of Ammonia
LCOE: Levelized Cost of Electricity
LCOH: Levelized Cost of Hydrogen
LOHC: Liquid Organic Hydrogen Carriers
METI: Ministry of Economy, Trade and Industry
MH: Maharastra
MJ: MegaJoule
MLIT: Ministry of Land, Infrastructure, Transport and tourism (Japan)
MMBTU / MMBtu: Million British Thermal Units
MMT: Million Metric Tonnes
MMTPA: Million Metric Tonnes Per Annum
MNRE: Ministry of New and Renewable Energy (India)
MRV: Monitoring, Reporting, and Verification
MoEFCC: Ministry of Environment, Forest and Climate Change (India)
MOTIE: Ministry of Trade, Industry and Energy
MoU: Memorandum of Understanding
MTPA: Million Tonnes Per Annum
NBP: National Balancing Point (UK virtual gas hub)
NG: Natural Gas
NGHM: National Green Hydrogen Mission
NOC: No-Objection Certificate
NYMEX: New York Mercantile Exchange
O&M: Operations and Maintenance
OD: Odisha
OGMP: Oil and Gas Methane Partnership
OPEX: Operating Expenditure
OTC: Over The Counter (bilateral trading off-exchange)
P2P: Peer-to-Peer
PB: Punjab
PEM: Proton Exchange Membrane (electrolyzer technology)
PLI: Production Linked Incentive
PNGRB: Petroleum and Natural Gas Regulatory Board (India)
PPA: Power Purchase Agreement
PSA: Pressure Swing Adsorption / Product Supply Agreement
PSU: Public Sector Undertaking
PSV: Punto di Scambio Virtuale (Italian gas hub)
PV: Photovoltaic (solar panels)
R&D: Research & Development
RE: Renewable Energy
REC: Renewable Energy Certificate
RED II / RED III: Renewable Energy Directive II / III (EU)
RFNBO: Renewable Fuels of Non-Biological Origin
RFQ: Request for Quotation
SCADA: Supervisory Control and Data Acquisition
SGST: States Goods & Service Tax
SIGHT: Strategic Interventions for Green Hydrogen Transition
RJ: Rajasthan
TN: Tamil Nadu
UP: Uttar Pradesh
WB: West Bengal

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Executive Summary (I/IV)

Compliance mandates and incentives may convert 10–15% of domestic grey molecule demand to green by 2030, with volumes doubling by 2035

- India has set an ambitious target to produce **5 million metric tonnes (MMT) of green hydrogen by 2030**, supported by a comprehensive policy and ecosystem development framework
- India's hydrogen demand is anchored by two distinct buyer segments. Anchor sectors consume ~7 MTPA of grey hydrogen sourced from imported gas under long-term contracts, while fragmented buyers across chemicals, explosives, and industrial users consume around 3 MTPA of ammonia and 3.1 MTPA of methanol, met through imports and surplus domestic feedstock.
- Driven by planned capacity expansions, anchor domestic hydrogen demand is projected to double over the same period
- Globally, green hydrogen demand is anticipated to rise from ~12 MTPA in 2030 to ~18 MTPA by 2035, driven largely by markets in Europe, Japan, and South Korea. This international growth directly supports India's export targets of 1.2–2.4 MTPA for green derivatives over the next decade.
- Consequently, compliance and policy pull are expected to shift 10–15% of anchor demand to green hydrogen, reaching ~0.4 MTPA by 2030 and ~1 MTPA by 2035 in the base case. Green ammonia demand is projected to grow to ~0.2 MTPA by 2030 and ~0.6 MTPA by 2035, with green methanol following a similar trajectory.

Molecule	Application	H2 demand scenarios KTPA (H2 eq)	GH2 demand scenarios (2030) KTPA (H2 eq)	GH2 demand scenarios (2035) KTPA (H2 eq)
1 Hydrogen	Refinery & Fertilizers	7068 – 9,581	328-657	786-1,571
	Chemicals, Steel, Industrial furnace based	220 – 2615	91-186	305-525
	Others (Cement, transport, power generation)	40 – 361	18-30	48-184
2 Ammonia	Export potential		1200-1400	2400 -2700
	Non-urea and others	3200 – 6,909	203-406	597-1,194
	Explosives & cold storage	350 – 756	10-20	30-60
3 Methanol	Chemical feedstocks and others	3000 – 6,638	230-470	668-1355

Note: Source: Primary discussions, mec+ analysis

Executive Summary (II/IV)

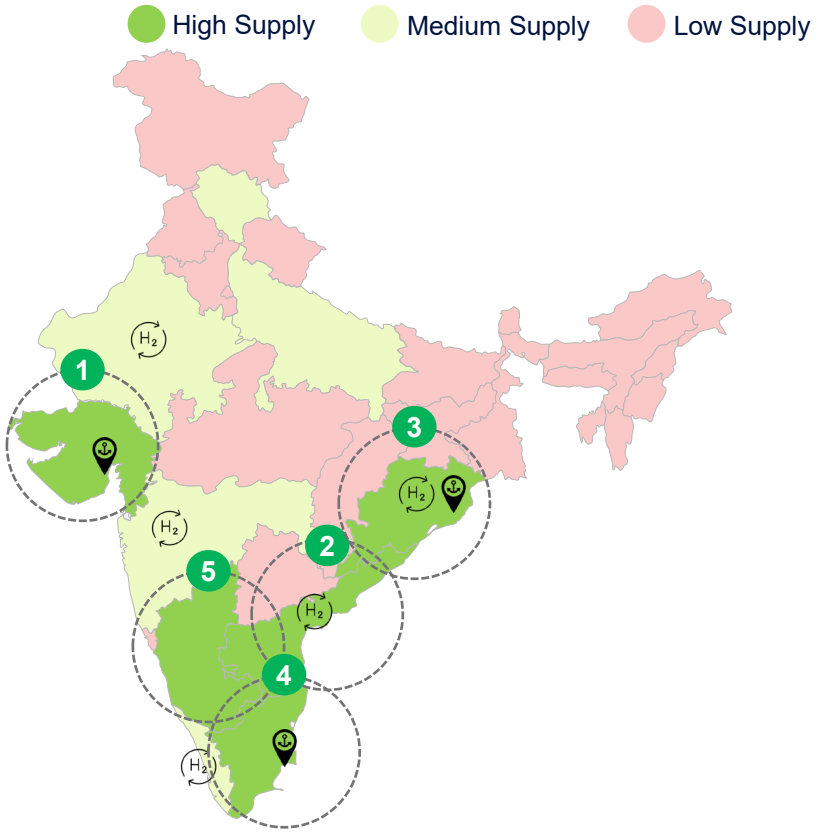
Substantial shift of 4–7% of total demand towards short-term trade, driven by production variability and spot exports **to yield 75–205 KTPA** of tradable green hydrogen , **82–175 KTPA of ammonia, and 38–105 KTPA** of methanol by 2035

- A 4–7% shift of total demand into short-term trade will create a highly liquid spot market (yielding up to 205 KTPA of hydrogen, 175 KTPA of ammonia, and 105 KTPA of methanol), driven by anchor sectors managing renewable intermittency and testing CCTS compliance, alongside industrial users such as cold storage units leveraging spot buying to substitute imports and hedge against grey market price volatility

Necessity to localize trading mechanisms within five strategic 250-km clusters to capture the constrained 269–496 KTPA short-term supply pool and bypass severe transport and execution bottlenecks

- On the supply side, 12.2 MTPA of green hydrogen and ammonia capacity has been announced in India; While post-NGHM initiatives have secured long-term green supply through targeted incentives, the vast majority of this capacity is tied up in long-term contracts.
- This leaves approximately 5% of the supply available for short-term trade by 2030, facilitated through contract flexibility and pilot projects with supply availability **of 269 KTPA by 2030 to 496 KTPA by 2035**
- The physical movement of these green molecules is severely limited by storage and transport infrastructure bottlenecks. Transport currently relies on tube trailers, where economics remain viable only up to a 250 km radius.
- These strict physical constraints drive the emergence of five strategic supply clusters (Gujarat , Odisha, Andhra Pradesh, Karnataka and Tamil Nadu) defined by the consolidation of supply and demand within this 250 km radius.

Mapping 5 supply clusters of Hydrogen & its derivatives



Note: Source: Primary discussions, mec+ analysis

Executive Summary (III/IV)

Imperative to launch a hybrid, MNRE-backed price index within 6 months to formalize the 200–500 KTPA short-term market and drive the transition from opaque bilateral contracts to transparent, platform-cleared price discovery

- Despite a clear **short-term trading potential of 200–500 KTPA** across green hydrogen, ammonia, and methanol, no nodal agency has yet been defined to enable this market.
- **Step 1 of the institutional build is to establish a trusted price index**, operationalizable in 6 months, that will anchor short-term price discovery and progressively replace bilateral opacity with platform-cleared transaction values as the market matures.
- The proposed approach is a hybrid price index: of five existing global hydrogen indices evaluated, three follow a cost-plus pricing model and two rely on a market-based approach; the proposed framework for India blends a calculated cost-plus baseline with Over-The-Counter (OTC) market quotes.
- The index formula calculates a range of GH2 and GNH3 values based on specific plant configuration factors and survey responses. To prevent manipulation, the formula's seven key parameters are tied to immutable data sources requiring institutional support from the MNRE.
- As the market matures, this hybrid price index will naturally evolve with the inception of short-term trading, systematically replacing market surveys with actual platform-cleared transaction values.
- The operational roadmap outlines a 6-month timeline to launch the Price Index, beginning with cost and survey-based methodology development (Months 0–4), followed by governance setup, back-testing, and final publication (Months 4–6).

Selection of proposed index for short term trade — Selected

	Index	Price index risk considerations
1	**Cost plus model : Supply based**	• **No variation in estimation of capex and O&M cost** over time • Assumptions for capex and O&M may not vary across supply clusters
2	**Market based model : SECI tender prices**	• Base assumptions of these prices is not available • **Frequency is not defined**
3	**Market based model : OTC prices**	• **High gap can be observed in prices quoted by supplier & buyers** • High dependance on market participants
4	**Hybrid model : Cost plus market based**	• **Dependance on market participants is limited** • Seller willing to provide base quoted prices to buyers • Global assumptions can be used for short term

Note: Source: Primary discussions, mec+ analysis

Executive Summary (IV/IV)

Execution of a phased 36-month platform roadmap, prioritizing a Phase 1 Go-Live (Months 18–24) with a listing-based, monthly pay-as-bid market localized to four initial hubs before scaling to cross-border integration and adjacent green products

- **Step 2 of the institutional build** will launch a pilot trading platform over a 36-month horizon, scaling from regional green hydrogen (GH2) and ammonia (GNH3) trade to full cross-border integration
- **Initial Products & Matching:** Based on stakeholder preferences, the platform will debut with a monthly pay-as-bid auction for GH2 and GNH3. To support this, a listing-based mechanism will match demand strictly within defined regional H2 clusters.
- **Trading Evolution:** Products will initially launch via an open pay-as-bid auction before transitioning to an open uniform bid model. Once market liquidity matures, the platform will deploy a hub-wise continuous trading framework.
- **Development Roadmap:** The first 12 months will focus on regulatory approvals, REC integration, and facility onboarding. Phase 1 (Months 18–24) launches domestic OTC trade, while later phases will expand into cross-border registries and new products (green methanol, SAF, and green steel).

Selection of proposed products for short term trade

Contract specifications	GH2	GNH3
	Product 1	Product 4
Contract type	Forward	Forward
Trading period	Monthly	Monthly
Purity as per definitions (GHG emissions over 12 months)	not exceeding 2 kg CO2 eq per kg of H2 produced	not more than 0.38 kg CO_2 eq per kg CO_2 eq /kg NH_3
Contract security and clearing venue	Exchange + Clearning house (in house)	Exchange + Clearning house (in house)
Trading model	Pay as bid	Pay as bid
Contract size	1 tonne	1 tonne
Minimum trading size	1 contract	1 contract
Quotation	INR per ton	INR per ton
Minimum price step	1 INR per ton	1 INR per ton
Maximum price step	No limit	No limit
Price range	No negative pricing	No negative pricing
Quantity range	Delivery tolerance upto 5%	Delivery tolerance upto 5%
Settlement mechanism	Physical delivery at buyer plant/gate	Physical delivery at buyer plant/gate

Note: Source: Primary discussions, mec+ analysis

Recommendations

High priority | Medium priority | Low priority

Theme		Recommendations
Price Index & Data Infrastructure	1	• **Establish MNRE-backed institutional support** to tie cost-plus index parameters (RE prices including CAPEX & OPEX of RE plants with OPEX grid charges, CAPEX and OPEX of electrolyser as per type and water source, and CAPEX/OPEX of ammonia)to immutable, verifiable data sources to prevent index manipulation
	2	• Maintain a live hydrogen project bank ensuring GH2 and GNH3 project costs are visible, and **formalise quarterly surveys of developers** and offtakers across all 5 selected clusters as the primary data feed
	3	• Create a **consolidated repository for hydrogen and derivatives regulations** with scheduled updates, covering central and state green open access regulations and state-specific incentives
	4	• Develop a **public observatory portal similar to European observatory model** publishing hydrogen production details, hydrogen/ammonia/methanol cost dashboards from survey data, electrolyser OEM manufacturing capacity, and infrastructure readiness
Regulatory Mandate for short term trade	5	• **Appoint nodal agency** to issue a No Objection Certificate (NOC) for operation of the OTC matching platform, confirming legal classification and compliance readiness
	6	• **Designate the regulator** empowered to establish regulatory standards for short-term trade of green hydrogen and green ammonia, and to set compliance requirements applicable to traded volumes

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India's anchor sectors consume ~7 MTPA of grey H2, sourced from imported gas under long-term contracts

High Medium Low | Natural gas Coal Oil | H2 requirement (kg) Demand (KTPA)

Overall demand outlook across industries where hydrogen is primary feedstock

Domestic Demand Type		Existing feedstock	Current process	Import Dependency	Contracts type	H2 per ton of end product* (Kg)	2025 H2 demand (KTPA)
Feedstock	Refinery		SMR → H_2	High	10-15 years of bilateral existing contracts	10	3,872
	Fertilizer - Urea		SMR → H_2 → NH_3	Medium	10-15 years of bilateral existing contracts	470	3,195
	Chemicals	Naphtha	SMR → H_2 *Naphtha reforming*	Medium	10-15 years of bilateral existing contracts	150	80
Process gas	Iron & Steel - DRI		*Limited use of H2*	Low	1-2 year short term annual contracts	54	140
	Cement		*Limited use of H2*	Low	1-2 year short term annual contracts	24	0
	Industrial furnace		SMR → H_2	Low	Long-term industrial supply arrangements	10	10
Blending/ co-firing	Transport		*Limited use of H2*	Low	NA	10	0
	Power generation		SMR → H_2	Low	1-2 year short term annual contracts	18	80
Total domestic hydrogen demand							7,377

Note: Definition

Fragmented buyers consume ~3 MTPA of Ammonia and ~3.1 MTPA of Methanol, met through imports and surplus domestic feedstock

Methanol | Natural gas | Ammonia

H2 requirement (kg) | Demand (KTPA)

Overall demand outlook across industries where hydrogen is primary feedstock

Domestic Demand Type		Existing feedstock	Current process	Import Dependency	Contracts type	Ammonia/Methanol per ton of end product (Kg)	2025 Ammonia/Methanol demand KTPA of H2 equivalent
Feedstock - Ammonia	Fertilizer – Non urea	Ammonia	Conversion →		10-15 years of bilateral existing contracts	220	2,500
	Explosives/Mining	Ammonia	Conversion → Nitrates		10-15 years of bilateral existing contracts	330	<100
	Refrigeration	Ammonia	Direct use		1-2 year short term annual contracts	Variable/Nominal Use	<100
	Others*	Ammonia	Conversion → Various compounds		1-2 year short term annual contracts	Variable/Nominal Use	500-600
Total domestic ammonia demand							3,000
Feedstock - Methanol	Chemical feedstock	Methanol	Conversion → Various compounds		Long-term industrial supply arrangements	1,000	3,000
	Others**	Methanol	Conversion → Various compounds		Long-term industrial supply arrangements	Variable/Nominal Use	100
Total domestic methanol demand							3,100

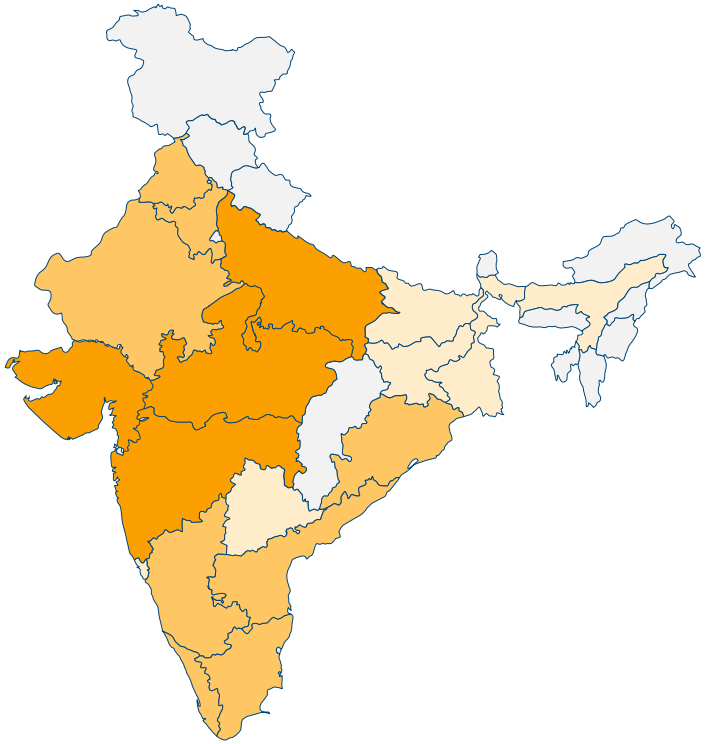
Natural trading hubs emerge where anchor and fragmented demand coincide predominantly across Western, Eastern and Southern India

Geographic concentration as of 2025 for anchor and fragmented demand areas

Anchor sector demand

Capacity (KTPA of equivalent H2)

- >500
- 250-500
- <250

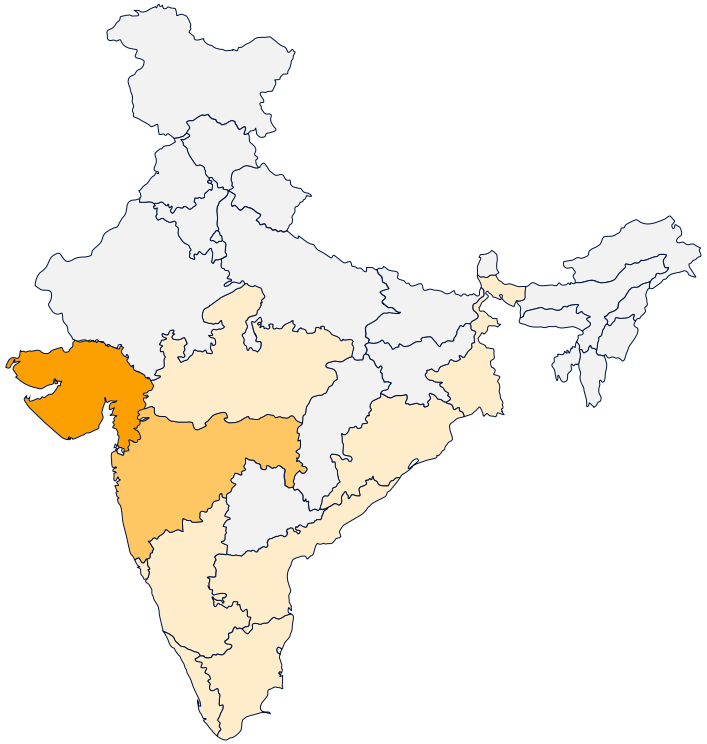


- Refineries
- Fertilizer
- Iron and steel
- Cement
- Industrial Furnace

Fragmented sector demand

Capacity (KTPA of equivalent H2)

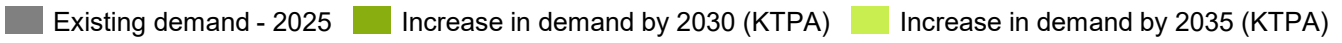
- >500
- 250-500
- <250



- Explosives
- Cold storage and others
- Chemical feedstock
- Others

Note: Definition

Anchor hydrogen demand is projected to grow from 7 MTPA to ~12.5 MTPA by 2035 as per planned expansions



Overall domestic anchor demand outlook across industries

Natural gas · Coal · Oil · Hydrogen · Methanol

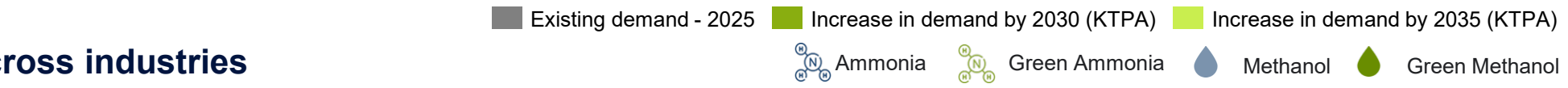
Application	Existing feedstock	Replaceable feedstock	Hydrogen demand expansion (KTPA)	Supply Requirements (Continuous/Batch)	Assumptions for increase
Refinery			3,872 → 6,129 (1,007 / 1,250)	Continuous	*Demand growth mainly from facility expansions and two new refineries in Tamil Nadu and Rajasthan*
Fertilizer – Urea based			3,196 → 3,452	Continuous	*Demand growth mainly from facility expansions and one new fertilizer unit in Namrup by 2030*
Chemicals	Naphtha		473	Continuous	*New demand driven by methanol projects and compliance with cleaner feedstock mandates*
Iron & Steel			1,374 → 2,094	Continuous	*Growth from hydrogen-based DRI projects emerging due to decarbonization mandates as per experts*
Cement			<0.1	Continuous	*Limited existing use; future demand linked to blending mandates and pilot projects.*
Industrial furnace			48	Continuous and batch	*Adoption expected only in niche applications under industrial decarbonization requirements*
Transport			161	-	*New demand to emerge from FCEV penetration and clean mobility mandates.*
Power generation			160	Continuous	*Potential demand from demonstration-scale projects in hydrogen co-firing*
Total			7,328 → 12,557		
Export based demand					

Note: Definition

Source: Primary discussions; GIZ demand database; ADBI – Indias's Green Hydrogen Review and perspective; Green Hydrogen Demand Assessment For C&I Consumers in India – WWF India 2024: mec+ analysis

Fragmented derivatives demand is expected to double by 2035, reaching ~7.6 MTPA of Ammonia and ~6.6 MTPA of Methanol

Overall demand outlook across industries



Application	Existing feedstock	Replaceable feedstock	H2/Ammonia/Methanol demand expansion	Supply Requirements (Continuous/Batch)	Assumptions for increase
Fertilizer – Non urea			5,829	Batch	
Explosives/Mining			540	Batch	*Currently small-scale scattered demand*
Refrigeration			216	Batch	*Currently small-scale scattered demand*
Others*			1,079	Batch	
Total ammonia expansion			7,664	Batch	
Chemical feedstock			6,477	Batch	
Others**			161	Batch	*Currently small-scale scattered demand*
Total methanol expansion			6,638	Batch	

Note: Definition

CCTS mandates are expected to shift anchor demand toward Green H2 across hard-to-abate sectors

Carbon Credit Trading Scheme (CCTS) Implementation Timeline and Targets

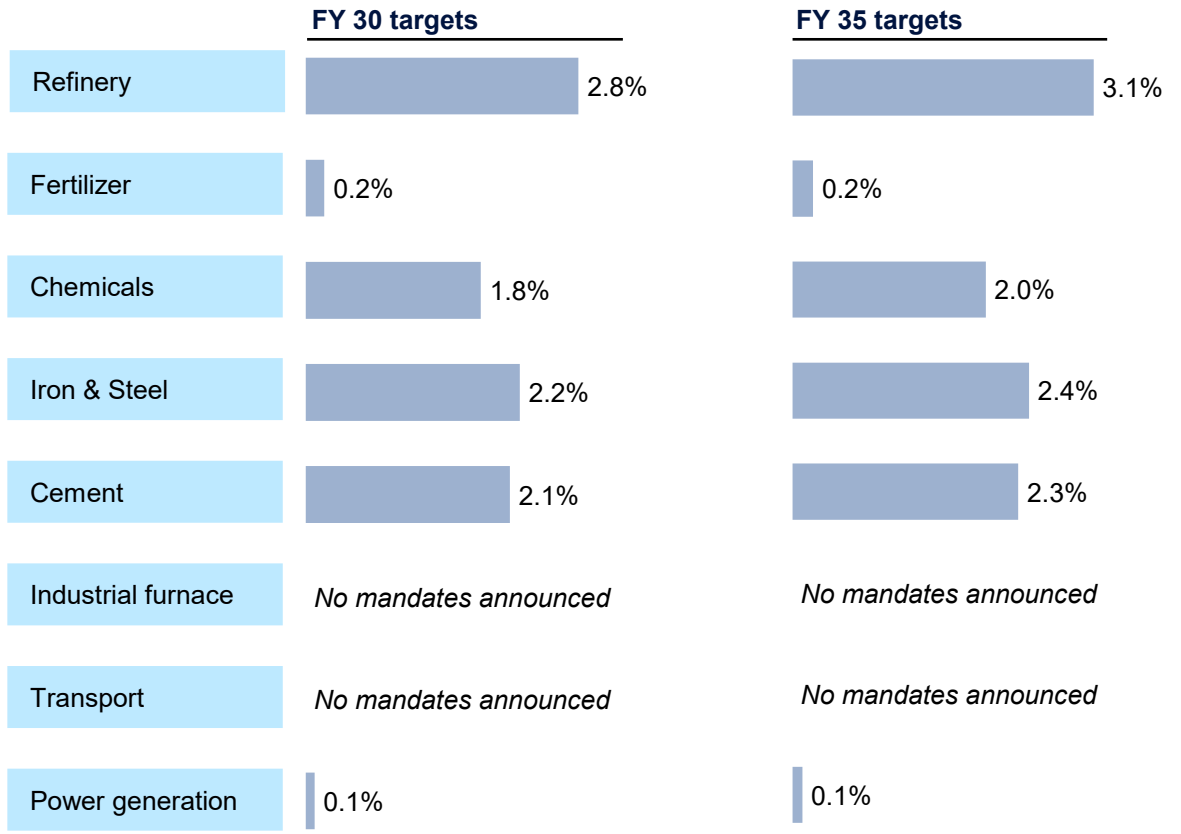
June 2023
Central Government of India notified the Carbon Credit Trading Scheme (CCTS). Subsequently, in October 2023, the Ministry of Environment, Forest and Climate Change (MoEFCC) further notified the Green Credit Rules

April 2025
BEE formally launched their first notification with entities under specific sectors starting to digitally track their emissions

June 2025
The companies complied must submit their Monitoring and Verification (MRV) plans for the CCTS program

April 2026
The entities after that will have to submit a 5-year action plan along with an annual activity plan for FY26

Annual emission reduction target under Carbon Credit Trading Scheme (CCTS)



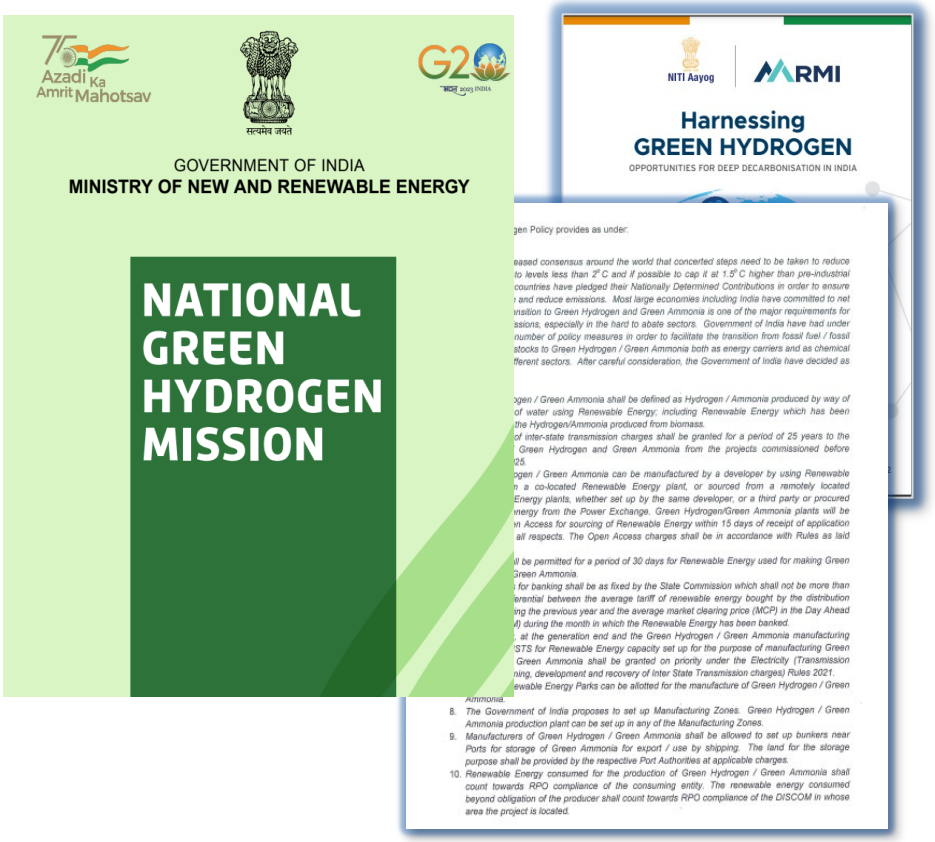
Note: Definition

NGHM-mandated pilots add a further layer of direct Green H2 demand

MNRE and NITI Aayog have published policy inputs

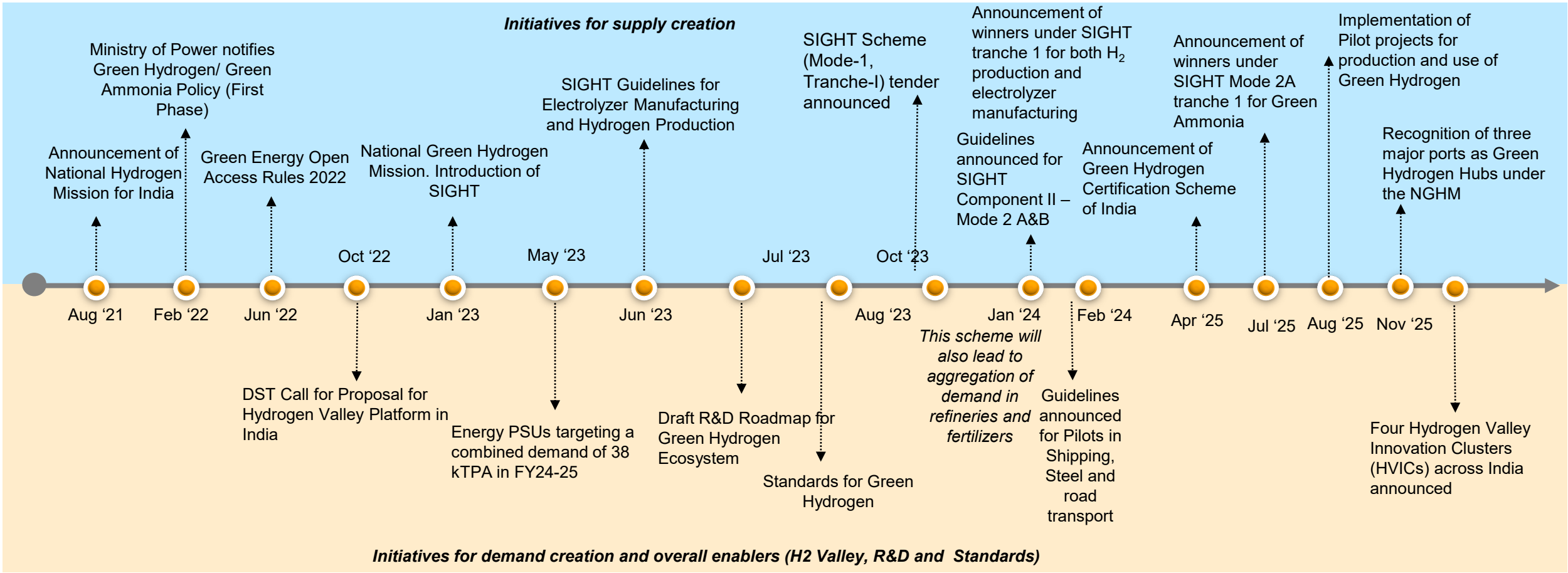
Vision & Targets	Net-zero by 2070; 5 MMT H_2 by 2030
Demand-Creation	Pilot offtakes; PSU MoUs; no blending mandates or ETS
Financial Incentives	PLI (₹1,350 cr electrolyzer; ₹9,400 cr H_2); CSS/AS & duty waivers; green fund proposed
Standards & Certification	Green Hydrogen Certification Scheme of India; Draft H_2 code; GoO pilot 2025; open-access grid rules
Infrastructure Planning	500 GW RE by 2030; state-level pipelines; concept export hubs
R&D & Demo Projects	400 cr R&D; 15 pilots; IIT centres; vocationnel modules
Governance & Implementation	MNRE Mission Secretariat; Empowered & Advisory Groups; state cells pilot
Monitoring & Engagement	MNRE dashboard; annual reviews; public comments; H_2A Council & Summits
International Collaboration	ISA membership; MoUs (Germany, Australia); WTO tariff draft

MNRE and NITI Aayog have published policy inputs



Note: Definition

Post-NGHM initiatives have secured long-term Green supply through targeted incentives



Note: Complementing national policies, state level policies announced are in regulatory overview section Definition

However, no nodal agency has been defined to enable short-term trade

	Stakeholders	Supporting stakeholders			
National Bodies	**MNRE** Pivotal in launching initiatives and programs aimed at advancing research, development, and deployment of green hydrogen	**Ministry of Petroleum and Natural Gas** The ministry is exploring and integrating green hydrogen within the petroleum and natural gas framework.	**Ministry of Road Transport and Highways** Likely focusing on adopting green hydrogen vehicles and integrating the technology into transport infrastructure.	**Department of Science and Technology** Initiatives likely focus on advancing innovation and technology in green hydrogen production, and applications.	**Port Authorities** Fostering of export based hubs
State Bodies	**State ministries** Providing targets, incentives and state specific capex support if any	**State energy and industrial departments** Enable project execution through land, power connectivity, and approvals.			
Planning and Implementing agencies	**MNRE** MNRE (Nodal ministry for policy formulation, coordination, financing, implementation)	**SECI** Project tenders, auctions, incentive disbursement			

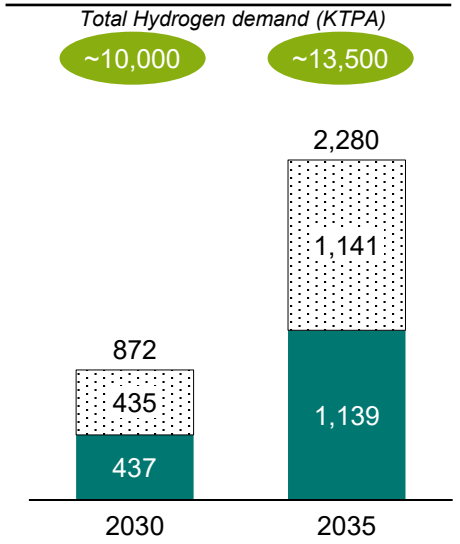
Compliance and policy pull shift 10–15% of anchor demand to Green H2, reaching ~0.4 MTPA by 2030 and ~1 MTPA by 2035 in base case

Overall GH2 demand outlook across industries

GH2 demand - base case (KTPA) | GH2 demand - optimistic case case (KTPA)
Existing demand - 2025 | Increase in demand by 2030 (KTPA) | Increase in demand by 2035 (KTPA)

Application	Hydrogen demand expansion (KTPA)	2030 GH2 demand scenarios	2035 GH2 demand scenarios
Refinery	6,129	488	1,226
Fertilizer	3,452	169	345
Chemicals	473	20	95
Iron & Steel	2,094	159	513
Cement*	<0.1	<0.1	<0.1
Industrial furnace	48	1	4
Transport	161	5	12
Power generation	160	30	85
Total	13,484	400-1,000	1,000-2,300

Cumulative GH2 demand scenarios



India could convert 5%-6% of its total hydrogen demand to green hydrogen by 2030, rising further to 10-15% by 2035

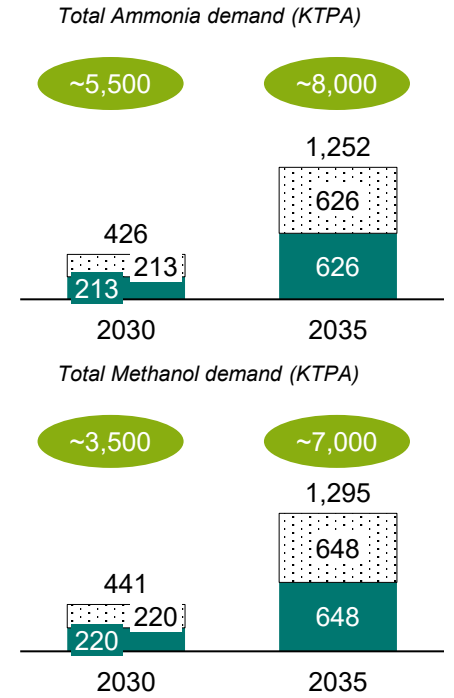
Green Ammonia demand grows to ~0.2 MTPA by 2030 and ~0.6 MTPA by 2035, with Green Methanol on a similar trajectory

Overall GH2 demand outlook across industries

GH2 demand - base case (KTPA) | GH2 demand - optimistic case case (KTPA)
Existing demand - 2025 | Increase in demand by 2030 (KTPA) | Increase in demand by 2035 (KTPA)

Application	Hydrogen equivalent of demand expansion (KTPA)	2030 Green ammonia/Methanol demand scenarios	2035 Green ammonia/Methanol demand scenarios
Fertilizer – Non urea	5,829	397	1,166
Explosives/Mining	540	18	54
Refrigeration	216	1	4
Others*	1,079	10	28
Total Ammonia	7,664	215-430	630-1 260
Chemical feedstock	6,477	441	1,295
Others	161	30	60
Total Methanol/GH2	6,638	220-440	650-1 300

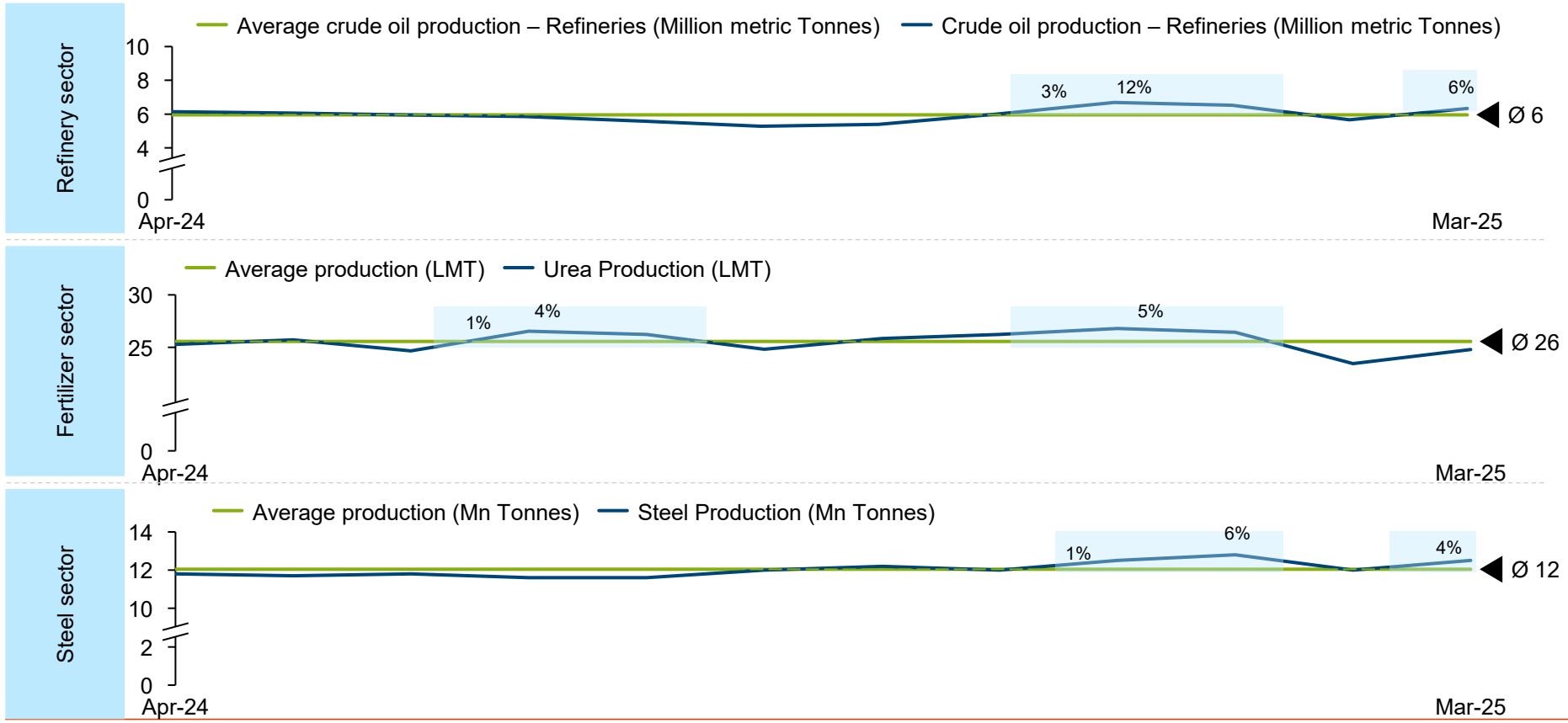
Cumulative green ammonia/methanol demand scenarios



Note: Complementing national policies, state level policies announced are in regulatory overview section Definition

Production variability is expected to push 4–7% of total demand into short-term trade by 2030–2035

Seasonal variations in production across industries and potential tradable volumes

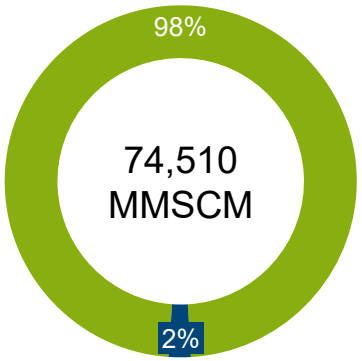


- Seasonal variations across core hydrogen consuming industries suggest that around 4-7% of the demand on average needs to be served outside the long-term contracts

Exchange benchmarks suggest a similar proportion translates to ~75 KTPA of Green H2 and ~30 KTPA of Green Ammonia short-term

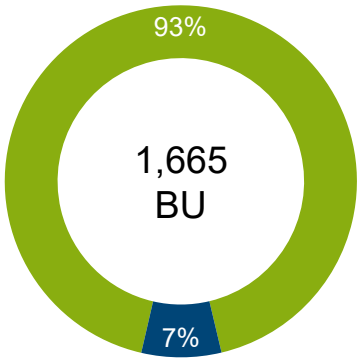
Trading volumes on major exchange platforms : FY 25

Natural gas consumption



IGX trading volumes

India electricity volumes



Power exchange trading volumes

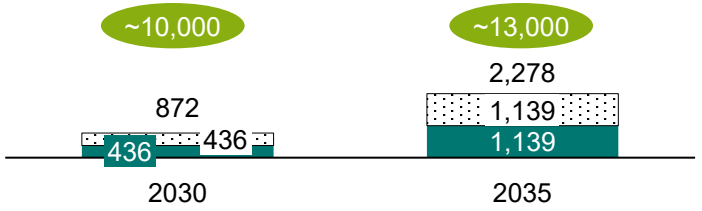
Analogous to other industries and commodity trade platforms, green hydrogen could see 4–7% of volumes becoming tradable

Potential GH2,green ammonia and green methanol volumes

Base case (KTPA) Optimistic case (KTPA)

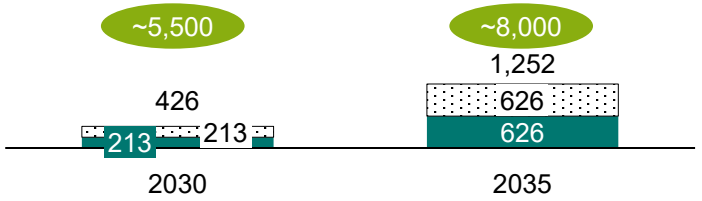
Green Hydrogen

Total Hydrogen demand (KTPA)



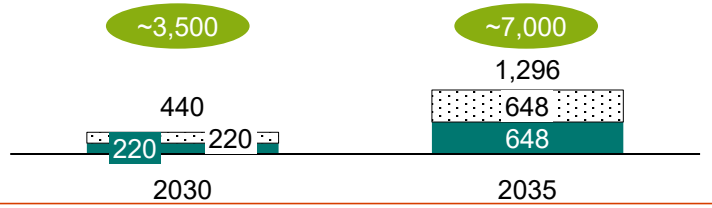
Green Ammonia

Total Ammonia demand (KTPA)



Green Methanol

Total Methanol demand (KTPA)

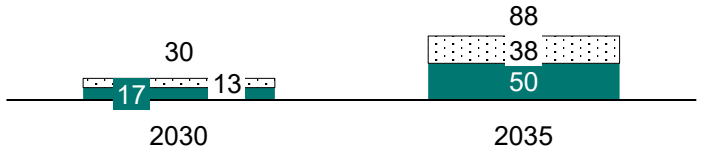


Potential tradable volumes

Green Hydrogen (KTPA)



Green Ammonia (KTPA)



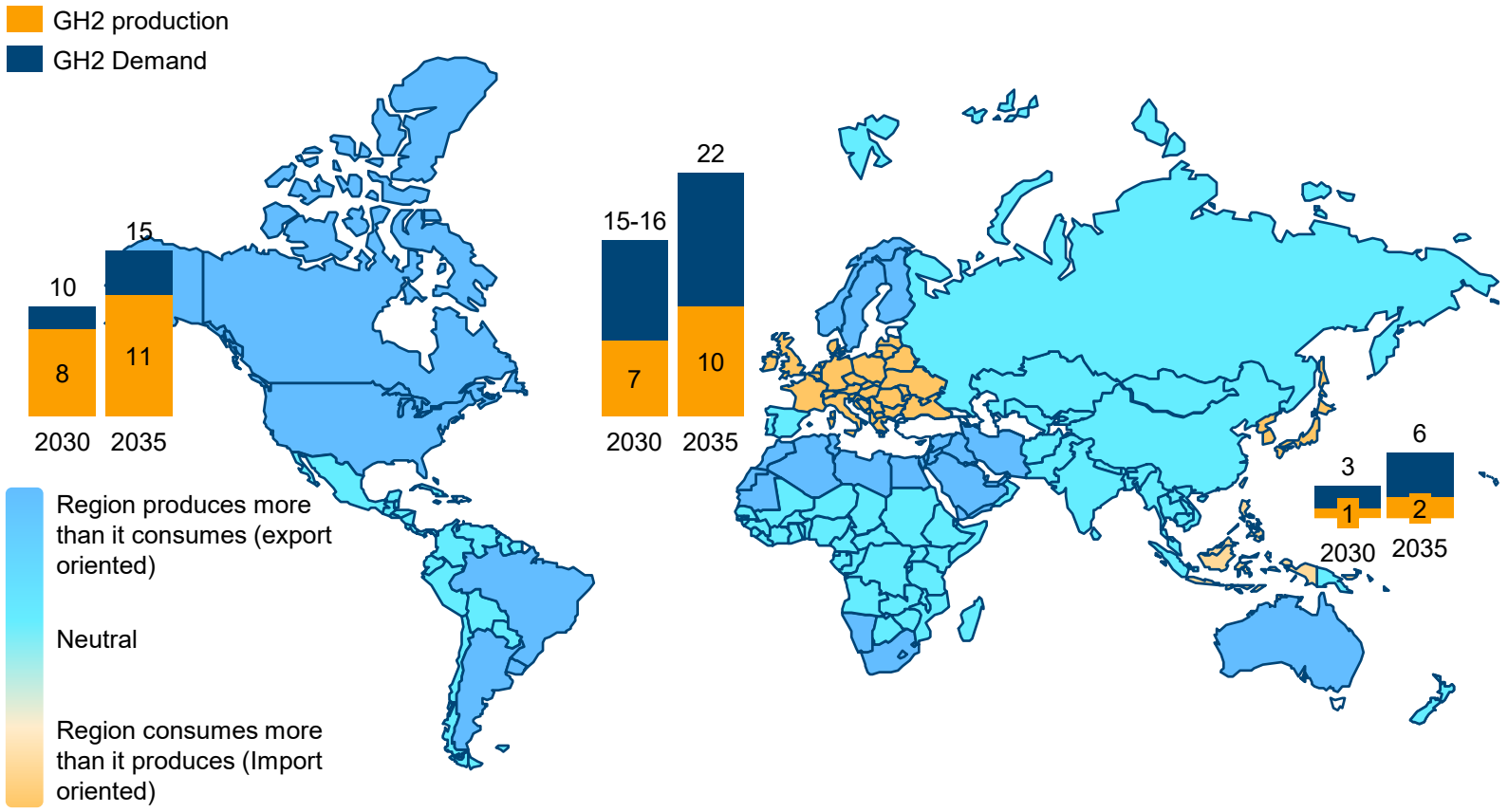
Green Methanol (KTPA)



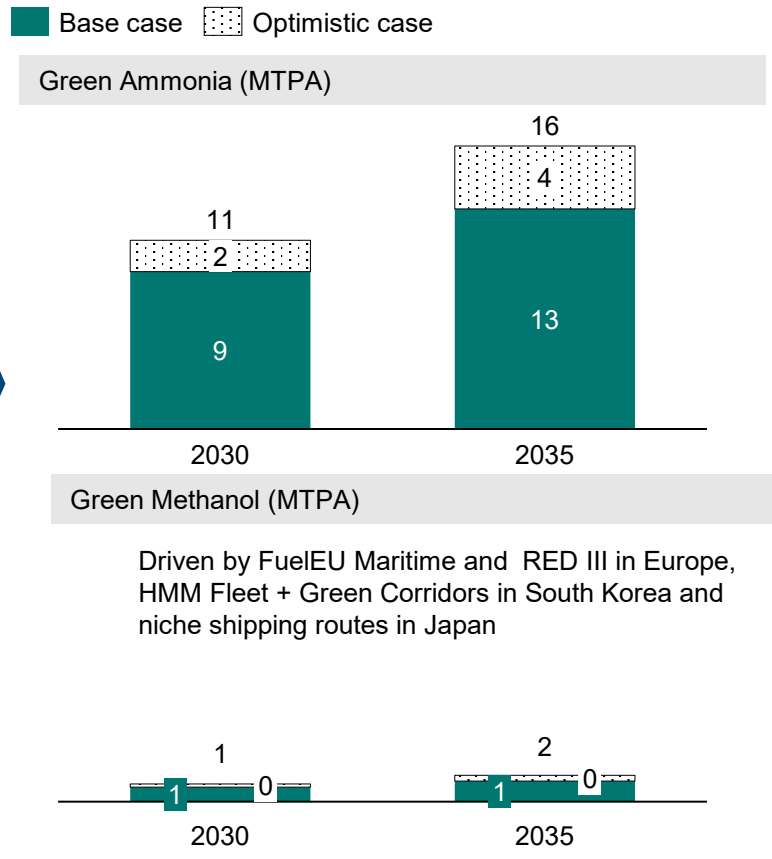
Additionally , global green H2 demand rises from ~12 MTPA in 2030 to ~18 MTPA by 2035, driven by Europe, Japan and South Korea

Major import centres

MTPA



Total GH2 demand in major geographies (MTPA)

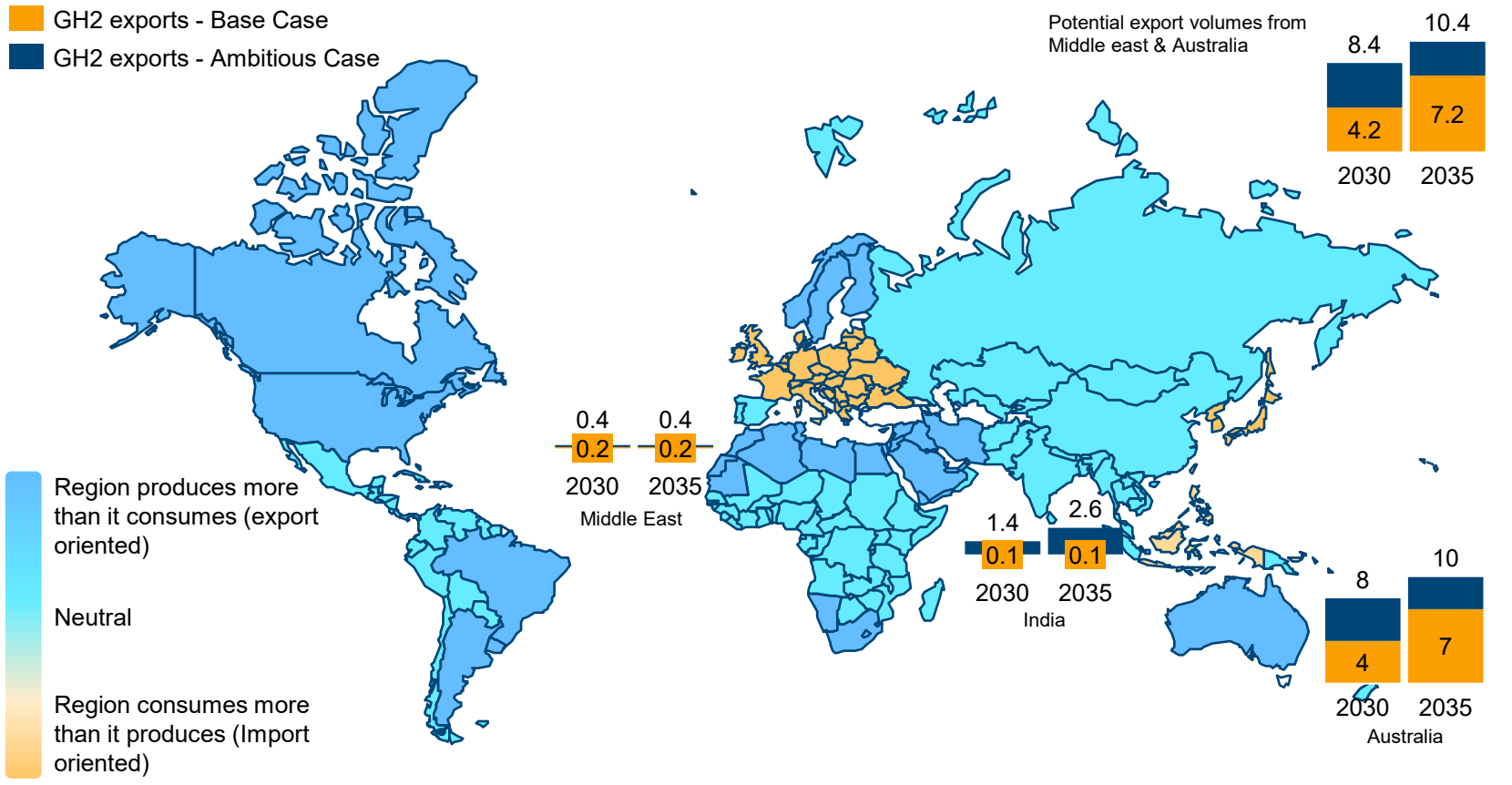


Note: Definition

India targets 1.2–2.4 MTPA of derivatives exports, of which 4–7% may clear on the spot market, adding ~50–100 KTPA over next decade

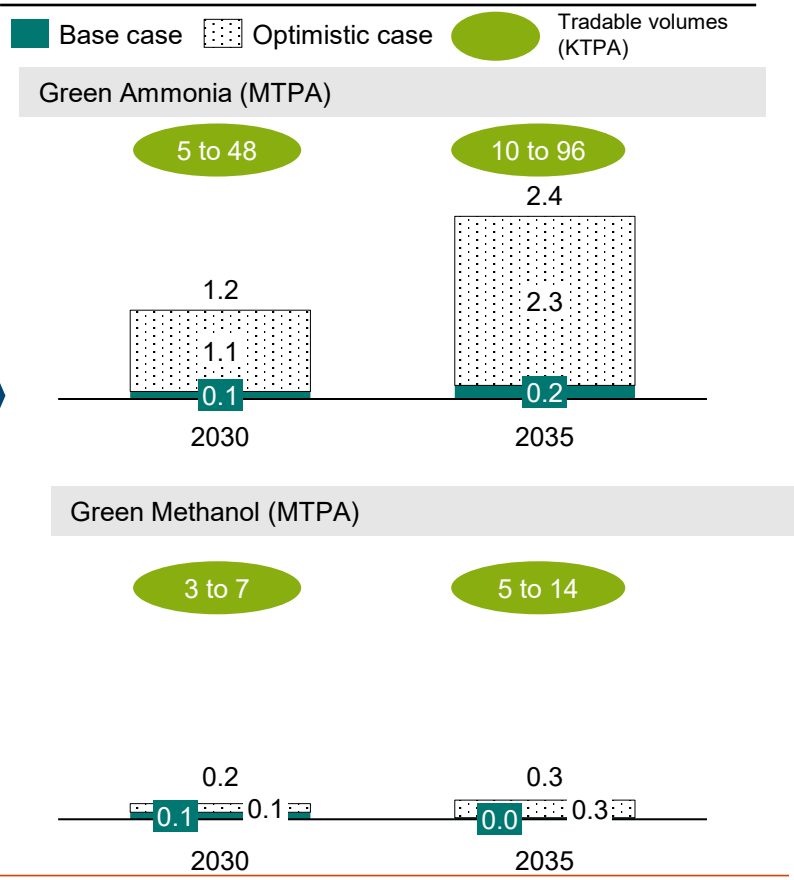
Major export centres

MTPA



Potential GH2 volumes for India

MTPA



By 2035, total tradable volumes (H2-equivalent) reach 75–205 KTPA of Hydrogen, 82–175 KTPA of Ammonia and 38–105 KTPA of Methanol

Overall opportunities for trading (H2-equivalent)

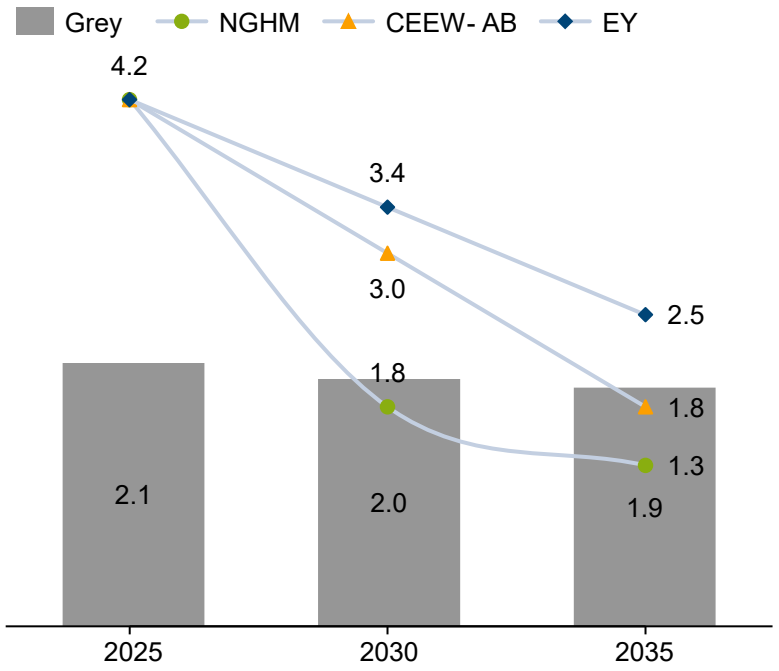
Ammonia | Hydrogen | Methanol | Base case | Aggressive case

Green Molecule	Geography	Sectors	Cumulative total volume (2030) KTPA	Cumulative total tradable volume (2030) KTPA	Cumulative total volume (2035) KTPA	Cumulative total tradable volume (2035) KTPA
1 Hydrogen		Chemical	436 436 872	49 26 75	1139 1139 2,278	138 67 205
		Steel				
		Industrial furnace based				
2 Ammonia		Explosives	213 213 426	17 13 30	626 626 1,252	50 38 88
		Cold storage				
		Non-urea fertilizers				
		Refinery and Fertilizer	100 1000 1,100	5 47 52	600 2000 2,600	10 86 96
		Transport				
3 Methanol		Chemical feedstock	220 220 440	18 13 31	648 648 1,296	52 39 91
		Others				
		Aviation	100 100 200	3 5 8	100 100 200	5 9 14
		Maritime (Shipping)				
Total				92 104 196		255 239 494

giz H2Uppp eex IGX mec+

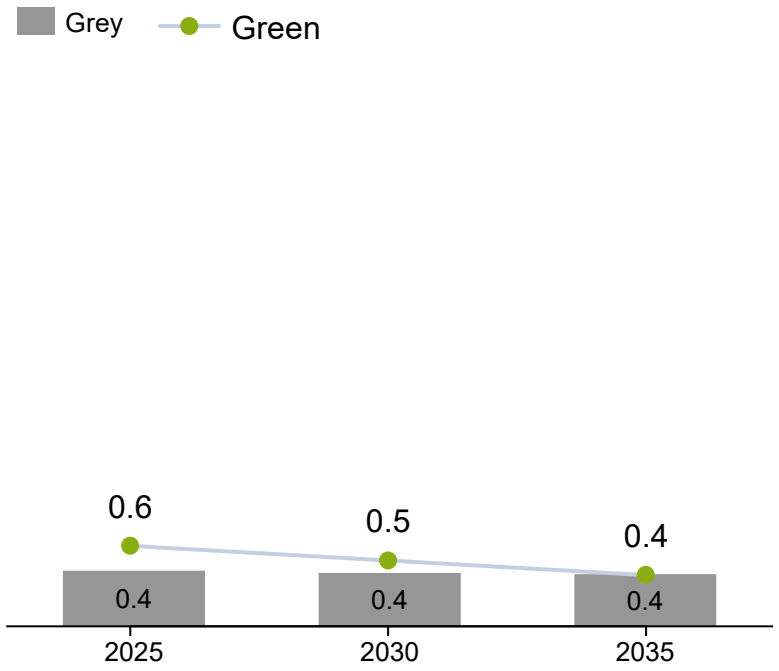
GH2 & derivatives costs ~1.5x to 2x grey today, with parity expected by 2030 unlocking latent demand into tradable volumes for green molecules

Grey vs Green Hydrogen price
$/ Kg



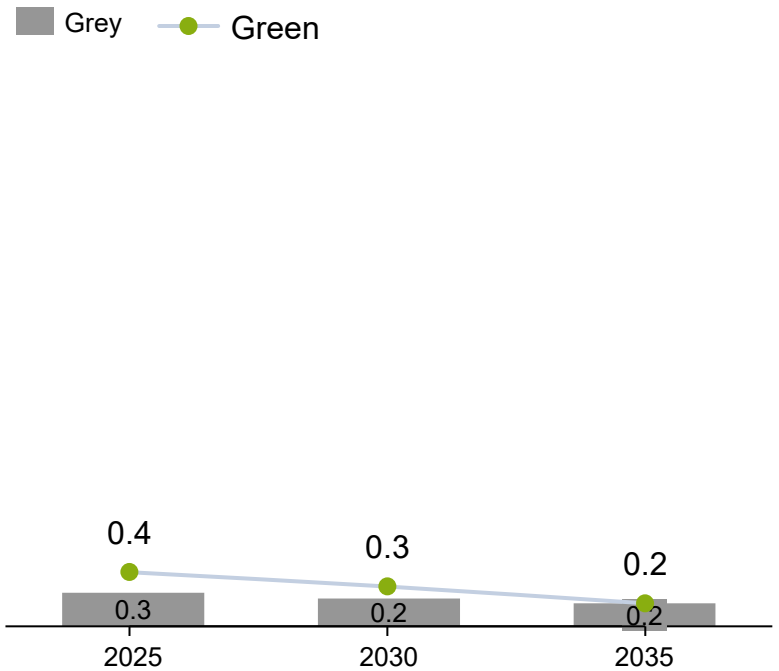
- Green hydrogen's premium over grey falls from 100% in 2025 to 30–50% by 2035, indicating strong cost convergence

Grey vs Green Ammonia price
$/ Kg



- Recent SECI auction had a price discovery of 0.65$/Kg which is expected to further reduce with technological innovation in future

Grey vs Green Methanol price
$/ Kg



- Green Methanol prices are expected to reach economic feasibility by 2035

Note: Definition

Green molecules short-term trade presents a $275–450M opportunity over the decade

Overall opportunities for trading (H2-equivalent)

Ammonia | Hydrogen | Methanol | Base case | Aggressive case

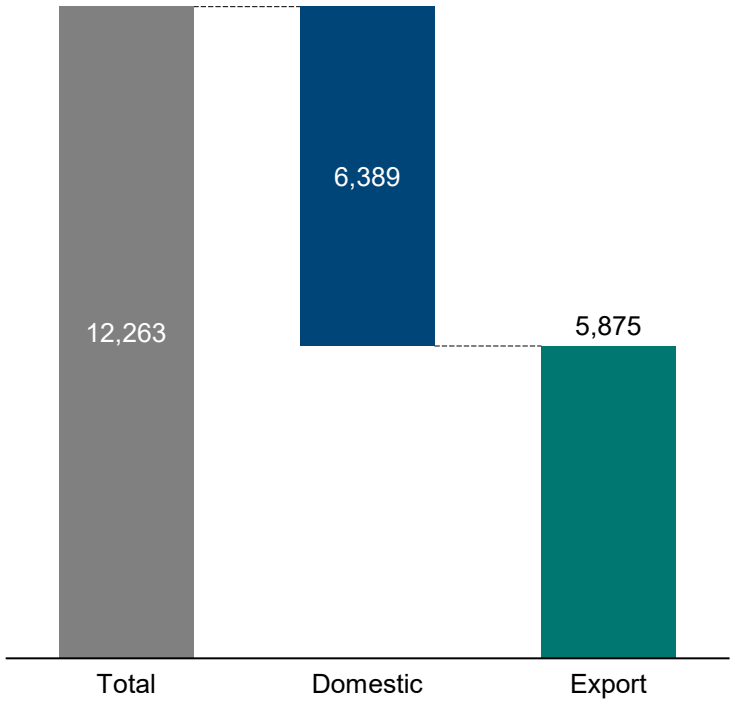
Green Molecule	Geography	Sectors	Cumulative total tradable volume (2030) KTPA	Cumulative total tradable value (2030) $M	Cumulative total tradable volume (2035) KTPA	Cumulative total tradable value (2035) $M
1 Hydrogen		Chemical	49 26 75	147 78 225	138 67 205	248 121 369
		Steel				
		Industrial furnace based				
2 Ammonia		Explosives	17 13 30	9 7 15	50 38 88	20 15 35
		Cold storage				
		Non-urea fertilizers				
		Refinery and Fertilizer	5 47 52	3 24 26	10 86 96	4 34 39
		Transport				
3 Methanol		Chemical feedstock	18 13 31	5 4 9	52 39 91	10 8 18
		Others				
		Aviation	3 5 7	1 2 3	5 9 14	1 2 3
		Maritime (Shipping)				
Total			92 104 196	165 115 280	255 239 484	284 180 464

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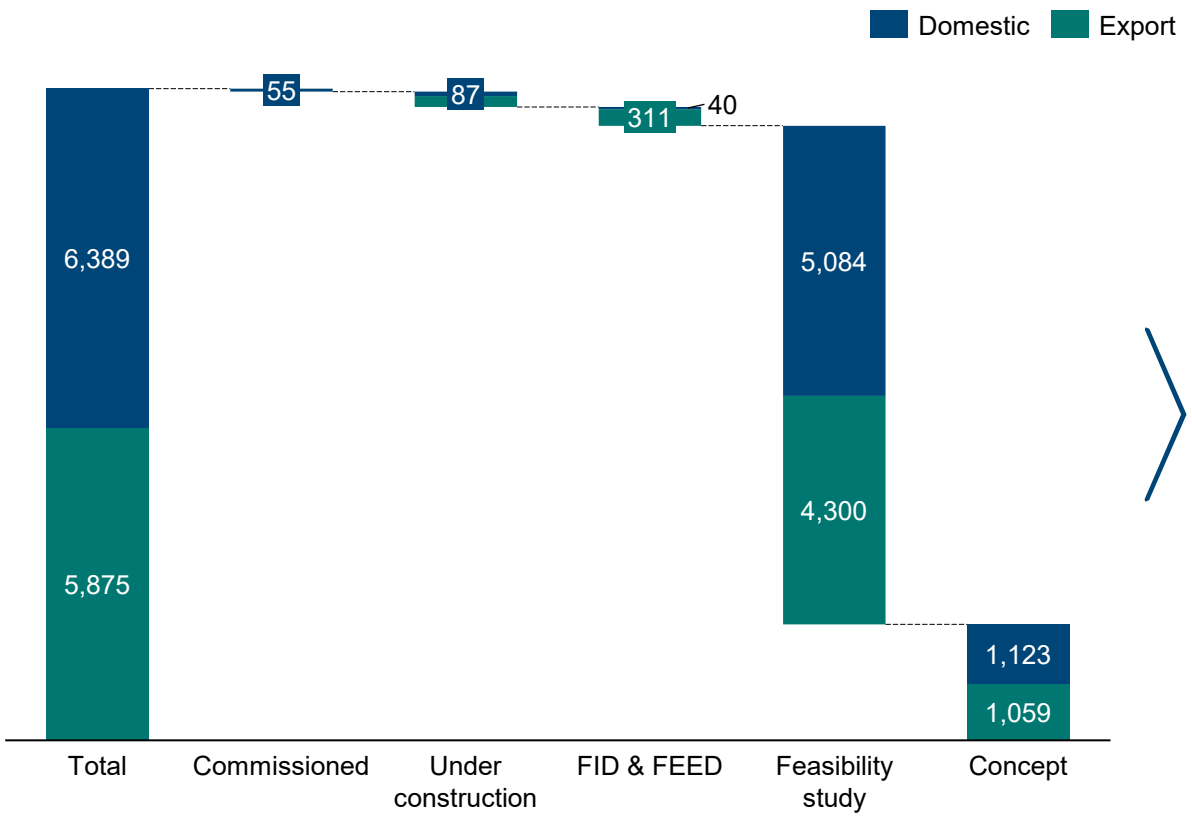
1	Background and framework introduction
2	Executive summary
3	Demand outlook
4	**Supply outlook**
5	Design of well functioning market – Price Index
6	Design of well functioning market – Trading model
7	Roadmap to launch a price index and trading platform
8	Global case studies of trading platforms
9	Regulatory overview : State policies and certifications

12.2 MTPA of Green Hydrogen and Green Ammonia supply has been announced in India, with only ~5% having reached FID

Green Hydrogen Supply breakdown
KTPA



Green Hydrogen Projects by Development Stage
KTPA

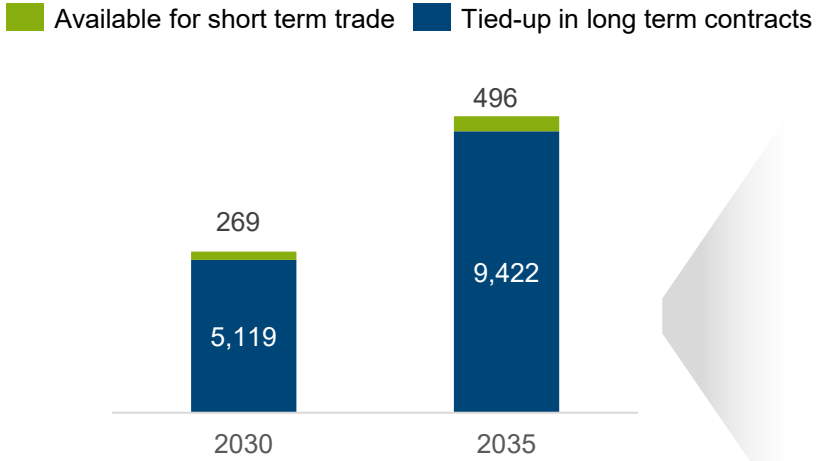


- Majority of domestic hydrogen (6,389 KTPA) sits in feasibility/concept stages; only 55 KTPA of projects are already commissioned

Note: Definition

Most of this supply is tied up in long-term contracts, leaving ~5% for short-term trade by 2030 through contract flexibility and pilot projects

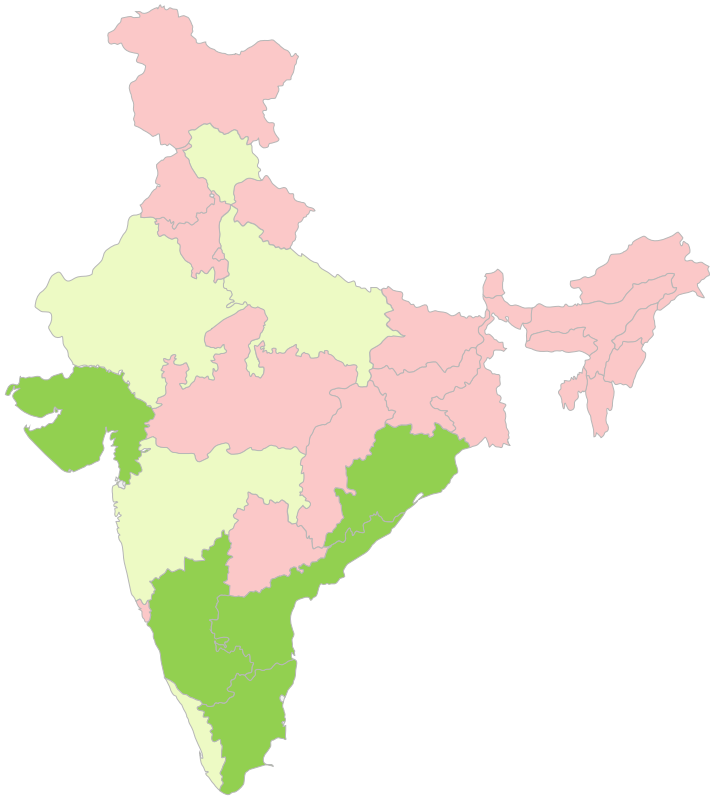
Green Hydrogen Supply available for short term trade (KTPA)



Factors driving supply for short term trade

- Pilot projects being developed by the developers
- Flexibility of up to 10% in existing contracts allowing potential for short tern trade

Supply cluster

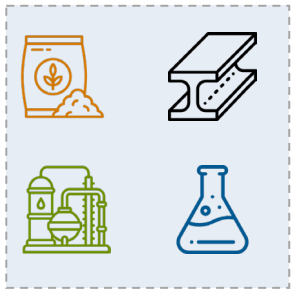
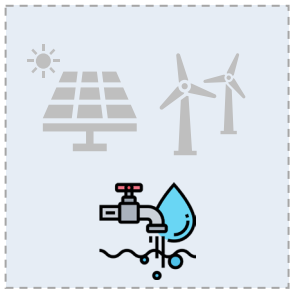
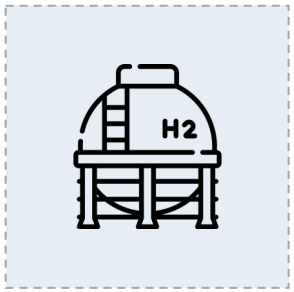
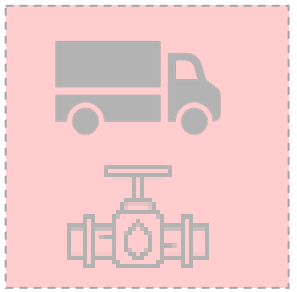
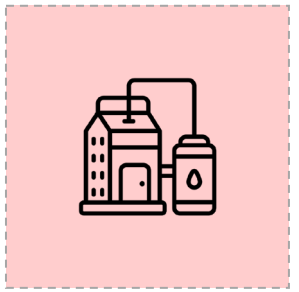
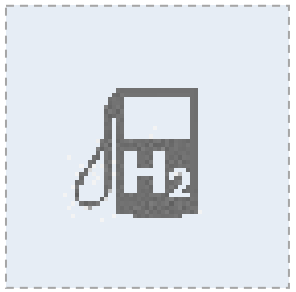


	State/ Cluster	Total Supply available for short term trade (KTPA)
1	Gujarat	81 + 78 = 160
2	Tamil Nadu	25 + 23 = 48
3	Odisha	33 + 21 = 54
4	Andhra Pradesh	76 + 65 = 141
5	Karnataka	15 + 15 = 31
6	Others*	40 + 23 = 63

However, infrastructure bottlenecks across storage and transport limit the movement of green molecules

Supply-chain of Green Hydrogen

No infra gaps | Infra gaps

	Demand	RE/ Water	Production of H_2	Transport	Storage	End user
Hydrogen						
India position	Abundant domestic and export demand of Green Hydrogen	Abundance of water availability and RE potential	With over 10 MMTPA of projects in pipeline, 5 MMTPA target of NGHM is still hard to achieve without clear policy mandates and incentives	No H_2 dedicated pipelines, transported via **high-pressure tube trailers, gas cylinders**	Storage infra under development on major ports	Multiple end-uses — refinery feedstock, fertilizer synthesis, and fuel— drive green hydrogen demand

Note: Definition

Green Hydrogen and Ammonia transport relies on tube trailers , where economics hold viable only up to 250 km

Nascent | Developing | Mature

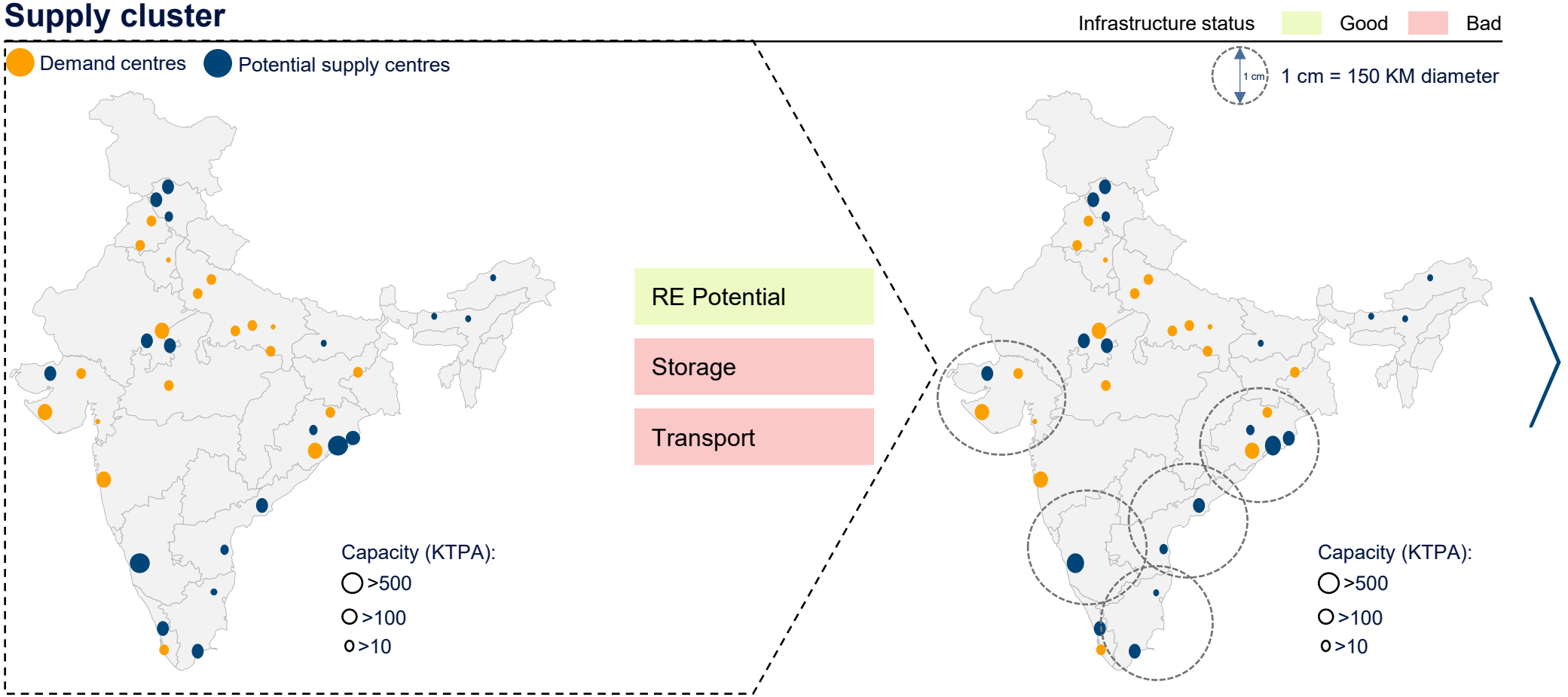
Transportation Mechanisms		Transportation Mechanisms	Volume- Global	Volume- India	Current State of Indian Infrastructure	Stakeholder
Land	H2 is transported via **high-pressure tube trailers, gas cylinders**.	High pressure tube-Trailers	◑	◕	Dominant transportation method	INOX AIR PRODUCTS, GAIL
		Cryogenic road tankers	○	◔	Operational but limited scale	INOXCVA, Air Liquide
		Metal hydrides cartridges	○	○	Metal hydrides cartridges is in R&D stage	
Pipeline	Focused on blending **H2 with existing Natural gas.**	Pipeline blending	◔	○	Operational at pilot stages but dedicated pipeline not planned till 2035	GAIL, adani Gas, NTPC
		Dedicated hydrogen pipeline	◔	○	Advanced planning and R&D stage.	TATA STEEL, Bharat Petroleum
Water	Focused on **marine shipping** and **port based bunkers** facility	Marine-based liquid & chemical H_2 carriers (LH_2 terminals, green ammonia/methanol, LOHC)	◔	◔	Pilot and early development, signed international partnership agreement.	NTPC, DEENDAYAL PORT AUTHORITY KANDLA

Note: Definition

giz H2Uppp eex IGX mec+

These constraints drive the emergence of five strategic clusters, defined by supply and demand consolidation within a 250 km radius

Supply cluster

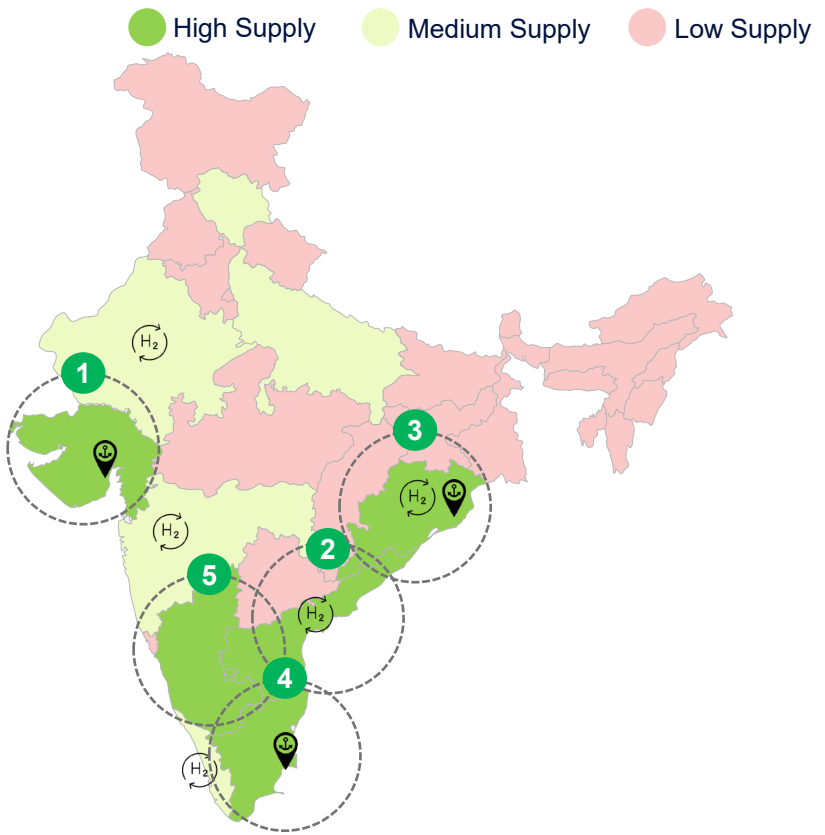


- 5 cluster states defined by demand and supply consolidation are :
  - **Gujarat**
  - **Odisha**
  - **Andhra Pradesh**
  - **Tamil Nadu**
  - **Karnataka**

Note: Definition

Government-announced hubs and innovation centres align with these five supply clusters, reinforcing their geographic consolidation

Mapping supply centers of Hydrogen & its derivatives



Proposed Valley/ Hubs

Selected cluster

Hydrogen Valley Innovation Cluster (HVIC)	Complete Green Hydrogen value chain—encompassing production, storage, transportation, and end-use—at a pilot scale as announced in August 2025	Pune Cluster, Maharashtra
		Bhubaneswar Cluster, Odisha
		Thiruvananthapuram and Kochi Cluster, Kerala
		Jodhpur Cluster, Rajasthan
Green hydrogen hubs	Designated geographic zones with a planned production capacity of at least 100,000 MTPA as announced in October 2025	Deendayal Port (Kandla), Gujarat
		V.O. Chidambaranar Port (Tuticorin), Tamil Nadu
		Paradip Port, Odisha

- 5 supply clusters namely are formed due to infra gaps- based on government designated Hubs and innovation clusters

Note: Announcements of MNRE on hubs and HVICs, Definition

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Short-term supply and demand fundamentals reveal a 200–500 KTPA trading potential across green hydrogen, ammonia and methanol

Demand centres

Overall opportunities for trading (H2-equivalent)

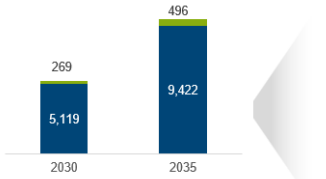
Ammonia | Hydrogen | Methanol | Base case | Aggressive case

Green Molecule	Geography	Sectors	Cumulative total volume (2030) KTPA	Cumulative total tradable volume (2030) KTPA	Cumulative total volume (2035) KTPA	Cumulative total tradable volume (2035) KTPA
1 Hydrogen		Chemical	436 436 872	49 26 75	1139 1139 2,278	138 67 205
		Steel				
		Industrial furnace based				
2 Ammonia		Explosives	213 213 426	17 13 30	626 626 1,252	50 38 88
		Cold storage				
		Non-urea fertilizers				
		Refinery and Fertilizer	100 1000 1,100	5 47 52	600 2000 2,600	10 86 96
		Transport				
3 Methanol		Chemical feedstock	220 220 440	18 13 31	648 648 1,296	52 39 91
		Others				
		Aviation	100 100 200	3 5 7	100 100 200	5 9 14
		Maritime (Shipping)				

Supply clusters

Green Hydrogen Supply available for short term trade (KTPA)

Available for short term trade | Tied-up in long term contracts

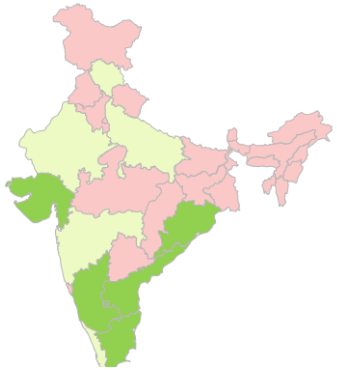


Factors driving supply for short term trade

- Pilot projects being developed by the developers
- Flexibility of up to 10% in existing contracts allowing potential for short tern trade

Supply cluster

High Supply | Medium Supply | Low Supply | Base case | Aggressive cas



	State/ Cluster	Total Supply available for short term trade (KTPA)
1	Gujarat	81 78 160
2	Tamil Nadu	25 23 48
3	Odisha	33 21 54
4	Andhra Pradesh	76 65 141
5	Karnataka	15 15 31
6	Others*	40 23 63

Potential for short-term trade

A Short-term **trade opportunity** of **75–205 KTPA** of **Hydrogen**, **82–175 KTPA** of **Ammonia** and **38–105 KTPA** of **Methanol** by **2035**

B **Supply** of **250-500 KTPA** available by **2035** to fulfil this demand

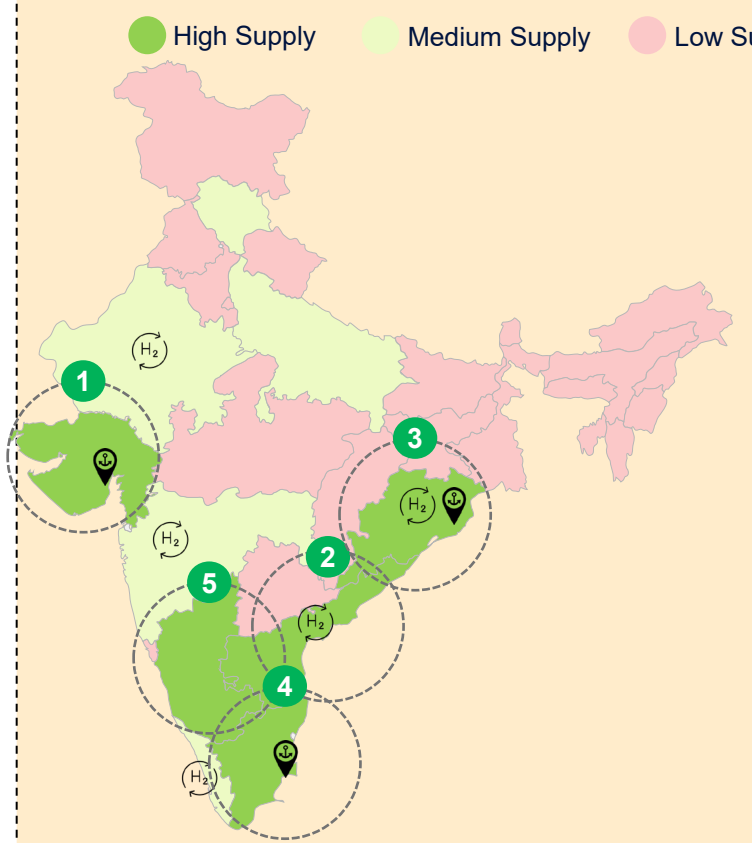
C Due to **exiting infrastructure bottlenecks**, short term **trade** can happen within **~250kms** of these **supply clusters**

Note: Definition

Source: Primary discussions; GIZ demand database; ADBI – Indias's Green Hydrogen Review and perspective; Green Hydrogen Demand Assessment For C&I Consumers in India – WWF India 2024: mec+ analysis

To capture trade volumes transparently and foster active market participation, establishing a trusted price index is the critical first step

Supply cluster



	State/ Cluster
1	Gujarat
2	Tamil Nadu
3	Odisha
4	Andhra Pradesh
5	Karnataka

A

Price index : Hybrid index based on supply side prices with market-based options

Index methodology choices:

- Methodology
  - Combination of Cost-plus index and market based index
- Frequency : Weekly or Monthly
- Area: Country based

B

Trading Model : Green hydrogen and derivative products

Key trading contract design choices to lock early:

- Trading period : Monthly/Quarterly
- Price mechanism : Closed RFQ based - Pay as bid/ Double-sided uniform pricing
- Delivery basis: ex-plant vs buyer's gate
- Quality standard: purity, pressure, moisture, contaminants, measurement method
- Settlement mechanism: physical v/s financial settlement

Note: *Others include Waste & Wastewater treatment, Rubber & textiles, Pharmaceuticals and cleaning agents; **Others include Olefins, formaldehyde, solvent applications, etc.;#∑ fix OPEX + (elec. price + elec. tax + GO)/η + Spec Water cost. + Spec Water demand/HHV, Definition
Source: Primary discussions; GIZ **hydrogen supply tool,** mec+ analysis

A

Globally, five hydrogen indices currently exist; three follow a cost-plus pricing model, and two rely on a market-based approach

Market based index | Cost plus index

	Index	Lauch	Product	Frequency	Formula	Units	Source	
1	HYDRIX : EEX (Germany)	May-2023	May-2023	Weekly	Market based index : HYDRIX = (∑Bid + ∑Ask) / 2	Index in EUR per MWh	Green hydrogen from electrolysis powered by renewables; priced on Lower Heating Value (LHV) basis	
2	HYDEX – Hydrogen Index(Germany)	Mar-2021	HydexPLUS Green	Daily	Electricity prices + Annualised Electrolyzer CAPEX + Water costs and other variable OPEX + Fixed O&M	Index in EUR per kg and EUR per MWh	Electricity prices as per wholesale markets	All other reference data for CAPEX and O&M from European Hydrogen Observatory
			Hydex12 Green	Daily			Electricity prices using the 12 cheapest hours to reflect high-RES periods	
3	HyXchange HYCLICX (Netherlands) – Hydrogen index	Jun-2023	HYCLICX(+) green 12h	Daily	Electricity prices + Green GOO+Tax on power+ Annualised Electrolyzer CAPEX + Water costs and other variable OPEX + Fixed O&M *Exclusions: Overheads, Grid costs, storage and transport costs,margins*	Index in EUR per kg and EUR per MWh	Electricity prices using the 12 cheapest hours to reflect high-RES periods	All other reference data for CAPEX and O&M from European Hydrogen Observatory, TNO's RhyCEET
			HYCLICX(+) green best 50%	Monthly			Electricity prices using the lowest-priced 50% of hours of electricity each month	
4	CEGH Green Hydrogen Index (Austria/CEE)	Dec-2022	CEGH GH2 Index – RED II and PPA 40	Daily	Electricity (PPA) /grid purchase per MWh H2 + costs GoOs per MWh H2 + CAPEX per MWh H2 +OPEX* = H2 costs per MWh H2 (Total) *Exclusions: Overheads, Grid costs, storage and transport costs,margins*	Index in EUR per MWh	PPA prices based on wind and PV projects in Austria as per Aurora	All other reference data for CAPEX and O&M from Austria on annualized basis
			CEGH GH2 Spot and Forward Index				Electricity prices using the Austrian spot prices and GoO published quarterly	
5	S&P Hydrogen assessments : India	Dec-2025	Long term offtake (Paradip)	Weekly	Market based inputs and in absence production cost modelling with monthly requirements as per region	Index in INR per kg	Electricity prices using the PPA based RE prices of region or exchange prices of grid	100 MW alkaline electrolyzer prices are considered at 25% load

Note: *Full OPEX integration in 2026,GoO : guarantees of origin, HYDRIX launched in May 2023 is market-based index based on (∑Bid + ∑Ask) / 2 formula hence not considered in list above , Definitions
Source: Hydex, Hyxchange and CEGH documents , mec+ analysis

A

The proposed price index utilizes a hybrid approach, blending a calculated cost-plus baseline with OTC market quotes

High Medium Low

Index	Formula	Units	Source	Frequency and area	Transparency	Price index risk considerations (Yes / No)
1 **Cost plus model : Supply based**	Electricity prices + Annualized Electrolyzer CAPEX + Water costs and other variable OPEX + Fixed O&M+ Fixed CAPEX NH3 production + Fixed OPEX of NH3	Index in INR per kg and EUR per kg	Electricity prices as per IEX or FDRE tenders All other reference data for CAPEX and O&M	Freq: Monthly Area: Country based		• **No variation in estimation of capex and O&M cost** over time • Assumptions for capex and O&M may not vary across supply clusters
2 **Market based model : SECI tender prices**	Average/median SECI bid prices of SIGHT tender (L1 and higher quotes)	Index in INR per kg and EUR per kg	SECI published prices	Freq: Not defined Area: Demand cluster		• Base assumptions of these prices is not available • **Frequency is not defined**
3 **Market based model : OTC prices**	Market based survey prices from supply and buyer side	Index in INR per kg and EUR per kg	Market based survey	Freq: Monthly Area: Demand cluster		• **High gap can be observed in prices quoted by supplier & buyers** • High dependance on market participants
4 **Hybrid model : Cost plus market based**	Range basis supply-based formula and market survey prices	Index in INR per kg and EUR per kg	Electricity prices as per IEX or FDRE tenders and market-based survey	Freq: Monthly(short term), Weekly (long term) Area: Demand cluster		• **Dependance on market participants is limited** • Seller willing to provide base quoted prices to buyers • Global assumptions can be used for short term

Note: Definition

Ensuring the integrity of the index requires institutional support from the MNRE to maintain immutable data sources

High priority | Medium priority | Low priority

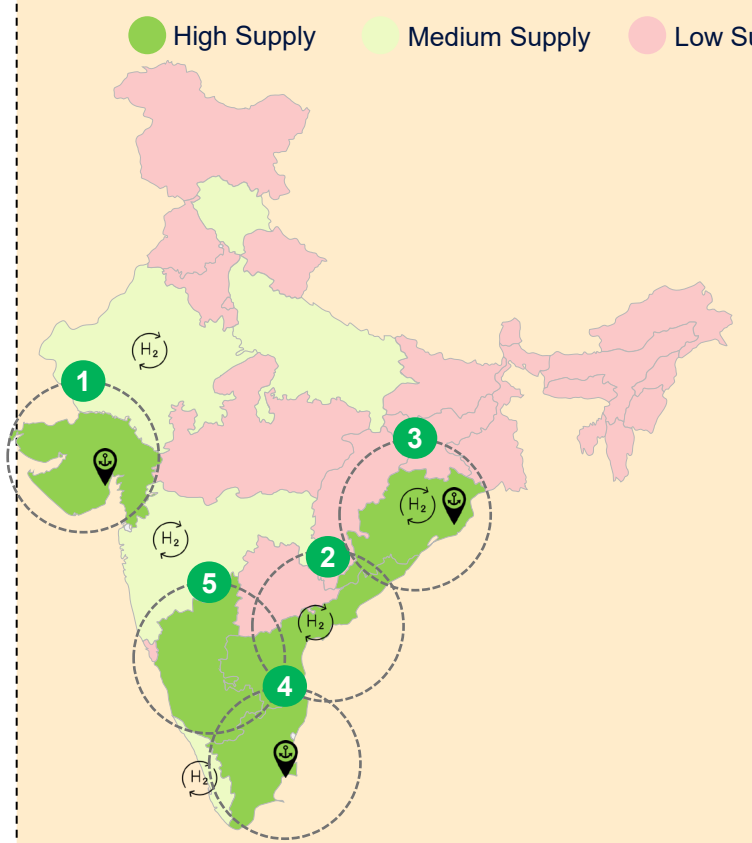
Theme		Recommendations
Price Index & Data Infrastructure	1	• **Establish MNRE-backed institutional support** to tie cost-plus index parameters (RE prices including CAPEX & OPEX of RE plants with OPEX grid charges, CAPEX and OPEX of electrolyser as per type and water source, and CAPEX/OPEX of ammonia)to immutable, verifiable data sources to prevent index manipulation
	2	• Maintain a live hydrogen project bank ensuring GH2 and GNH3 project costs are visible, and **formalise quarterly surveys of developers** and offtakers across all 5 selected clusters as the primary data feed
	3	• Create a **consolidated repository for hydrogen and derivatives regulations** with scheduled updates, covering central and state green open access regulations and state-specific incentives
	4	• Develop a **public observatory portal similar to European observatory model** publishing hydrogen production details, hydrogen/ammonia/methanol cost dashboards from survey data, electrolyser OEM manufacturing capacity, and infrastructure readiness

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To actualize the short-term trading potential unlocked by price index, establishing a pilot trading platform is the essential next step

Supply cluster



	State/ Cluster
1	Gujarat
2	Tamil Nadu
3	Odisha
4	Andhra Pradesh
5	Karnataka

A

Price index : Hybrid index based on supply side prices with market-based options

Index methodology choices:

- Methodology
  - Combination of Cost-plus index and market-based index
- Frequency : Weekly or Monthly
- Area: Country based

B

Trading Model : Green hydrogen and derivative products

Key trading contract design choices to lock early:

- Trading period : Monthly/Quarterly
- Price mechanism : Open RFQ based - Pay as bid/ Double-sided uniform pricing
- Delivery basis: ex-plant
- Quality standard: purity, pressure, moisture, contaminants, measurement method
- Settlement mechanism: physical v/s financial settlement

Note: *Others include Waste & Wastewater treatment, Rubber & textiles, Pharmaceuticals and cleaning agents; **Others include Olefins, formaldehyde, solvent applications, etc.;#∑ fix OPEX + (elec. price + elec. tax + GO)/η + Spec Water cost. + Spec Water demand/HHV, Definition

Source: Primary discussions; GIZ demand database; ADBI – Indias's Green Hydrogen Review and perspective; Green Hydrogen Demand Assessment For C&I Consumers in India – WWF India 2024: mec+ analysis

B

To build this platform, we evaluated 5 global trading models and shortlisted 2 that are best suited for the Indian short-term context

High Medium Low Yes No

Trading models evaluated	Suitable for Liquidity	Settlement and delivery	Price discovery	Time to operationalise	Transparency	Global case examples*	Considerations for short term trading model
1 **Uniform Price Auction (Double sided)**	**Low to medium** market liquidity	**Physical with single or multi hubs**	Single clearing price	12 to 18 months	High	EEX gas spot, IGX contracts	• Strong regulatory precedence • Suitable for low to medium liquidity • High transparency and suitable time to operationalize
2 **Pay as bid auction**	**Low to medium** market liquidity	**Physical with multi hubs**	Multiple dispersed prices	Less than 12 months	High	H2 global supply side case UK based NBP	• Suitable for low to medium liquidity • High transparency but dispersed prices • Highly attractive for short-term models due to a short timeline to operationalize
3 **Continuous trading**	**High** market liquidity	**Physical with single hub**	Continuous prices	12 to 18 months	High	ICE TTF spot and futures	• Requires market maturity and can be part of future trades • Ensure hub wise physical delivery • Demands moderate runway to operationalise
4 **Contract for difference**	**Low to medium** market liquidity	**Reference hub**	Strong as Indian exchanges	More than 24 months	High	H2 global demand side case	• Long implementation timeline & dependence on government • Tool for long term risk insulation not suitable for short term trade • Regulatory and structural complexity
5 **Bilateral OTC supply**	**Low** market liquidity	**Physical as per bilateral**	Strong as Indian trades (LNG)	Less than 6 months	Low	EEX gas spot, IGX contracts	• Fastest model to operationalize • It is not transparent as closed transaction • Can have customized terms as per requirements

Note: Definition

B

Designing a relevant intrastate model requires selecting optimal contract specifications across 14 key parameters

Parameters evaluated for finalisation of trading product contract specifications

1 Contract type	Spot	Forward	Futures & Options	Long term bilateral contracts
2 Trading period	Intraday & Day ahead	Weekly	Monthly	Quarterly
3 Gas product and purity as per definitions	Hydrogen	Ammonia	Methanol	
4 Contract security and clearing venue	Clearing house	Exchange	Exchange + Clearing house (in-house)	
5 Trading model	Continuous trading	Open : Double sided uniform price	Open: Pay as bid	Over the counter
6 Contract size	1 ton	10 ton	100 ton	
7 Minimum trading size	1 contract	5 contracts	10 contracts	
8 Quotation	INR per ton	INR per MMBtu	USD per ton	USD per MMBtu
9 Minimum price step	1 INR per kg	1 INR per MMBtu	1 USD per kg	1 USD per MMBtu
10 Maximum price step	No limit	Limit as per delivery	Limit as per previous close	
11 Price range	Dynamically adjusted trading bands	No negative pricing	Pre defined floor and ceiling	
12 Quantity range & tick	1kg	100 kg		
13 Settlement mechanism	Physical delivery at hub	Physical delivery at customer plant/ gate	Financial settlement	
14 Settlement price	Single uniform price	Price as per bid	Financial settlement	

B

Guided by stakeholder preferences, an initial monthly pay as bid product may be launched for GH2 and GNH3

Tier expansion as per pilot response

Contract specifications	Green Hydrogen			Green Ammonia			Green methanol
	Product 1	Product 2	Product 3	Product 4	Product 5	Product 6	
Contract type	Forward	Forward	Forward	Forward	Forward	Forward	• **Limited Supply in comparison to green ammonia projects:** Market liquidity is low because the limited green methanol supply setup and available capacity is already tied up in long-term agreements • **Certification Hurdles:** Complex carbon intensity and emissions certifications required to verify the green methanol along with hydrogen certifications
Trading period	Monthly	Monthly	Quarterly	Monthly	Monthly	Quarterly	
Purity as per definitions	To qualify as "green," the hydrogen must have non-biogenic GHG emissions not exceeding 2 kg CO2 eq per kg of H2 produced over 12 months, Purity : 99.9%+			To qualify as "green," the NH_3 shall have total GHG emission of not more than 0.38 kg CO_2 equivalent per kg CO_2 eq /kg NH_3) over 12 month period; Purity:99.5%+			
Contract security and clearing venue	Exchange + Clearning house (in house)	Exchange + Clearning house (in house)	Exchange + Clearning house (in house)	Exchange + Clearning house (in house)	Exchange + Clearning house (in house)	Exchange + Clearning house (in house)	
Trading model	Pay as bid	Double sided uniform price	Double sided uniform price	Pay as bid	Double sided uniform price	Double sided uniform price	
Contract size	1 tonne	10 tonne	10 tonne	1 tonne	10 tonne	10 tonne	
Minimum trading size	1 contract	1 contract	1 contract	1 contract	1 contract	1 contract	
Quotation	INR per ton	INR per ton	INR per ton	INR per ton	INR per ton	INR per ton	
Minimum price step	1 INR per ton	1 INR per ton	1 INR per ton	1 INR per ton	1 INR per ton	1 INR per ton	
Maximum price step	No limit	No limit	No limit	No limit	No limit	No limit	
Price range	No negative pricing	No negative pricing	No negative pricing	No negative pricing	No negative pricing	No negative pricing	
Quantity range	Delivery tolerance upto 5%	Delivery tolerance upto 5%	Delivery tolerance upto 5%	Delivery tolerance upto 5%	Delivery tolerance upto 5%	Delivery tolerance upto 5%	
Settlement mechanism	Physical delivery at buyer plant/gate	Physical delivery at buyer plant/gate	Physical delivery at buyer plant/gate	Physical delivery at buyer plant/gate	Physical delivery at buyer plant/gate	Physical delivery at buyer plant/gate	
Settlement price	Price as per bid	Price as per bid	Price as per bid	Price as per bid	Price as per bid	Price as per bid	

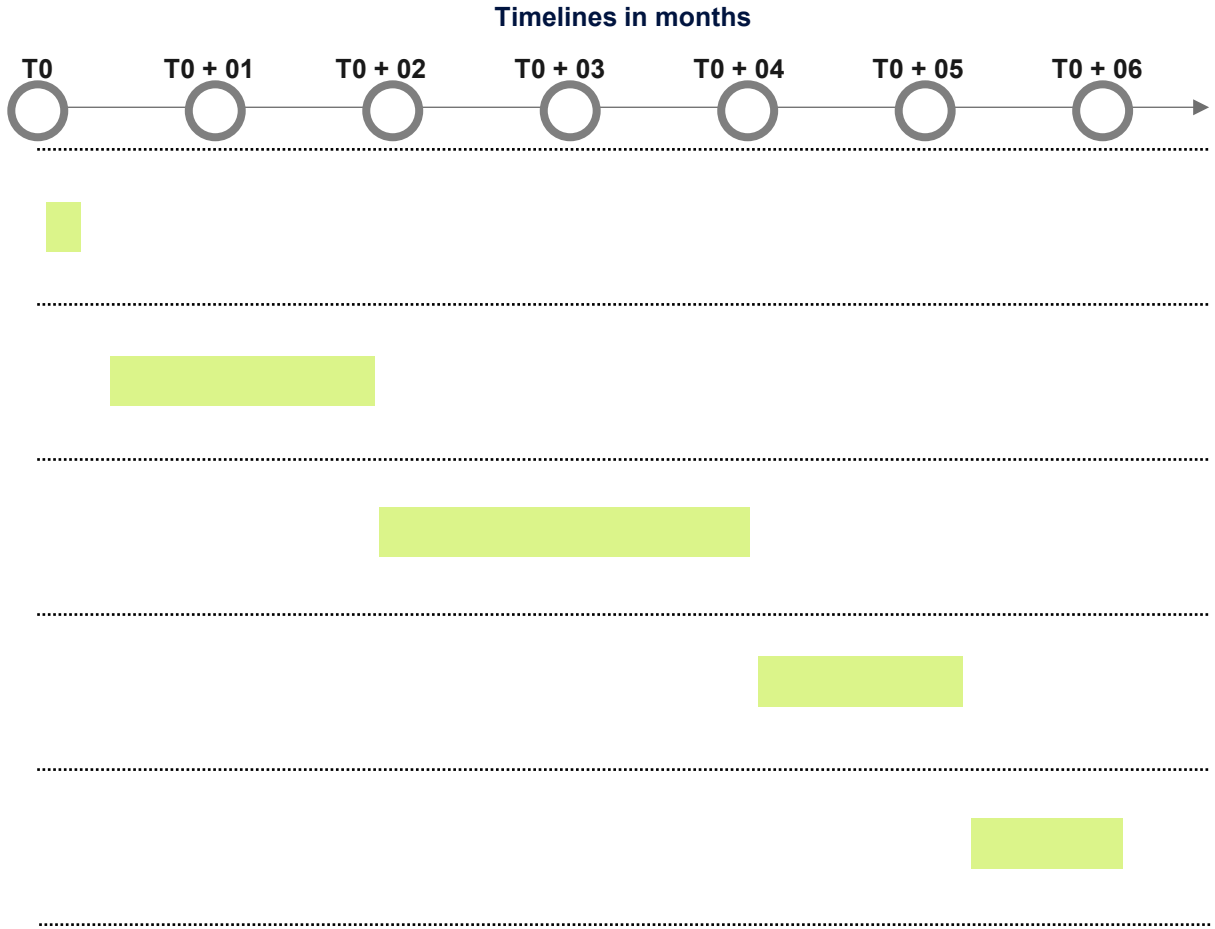
Note: Definition of ammonia, Definition

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Price Index of GH2 and GNH3 can be launched in 6 months

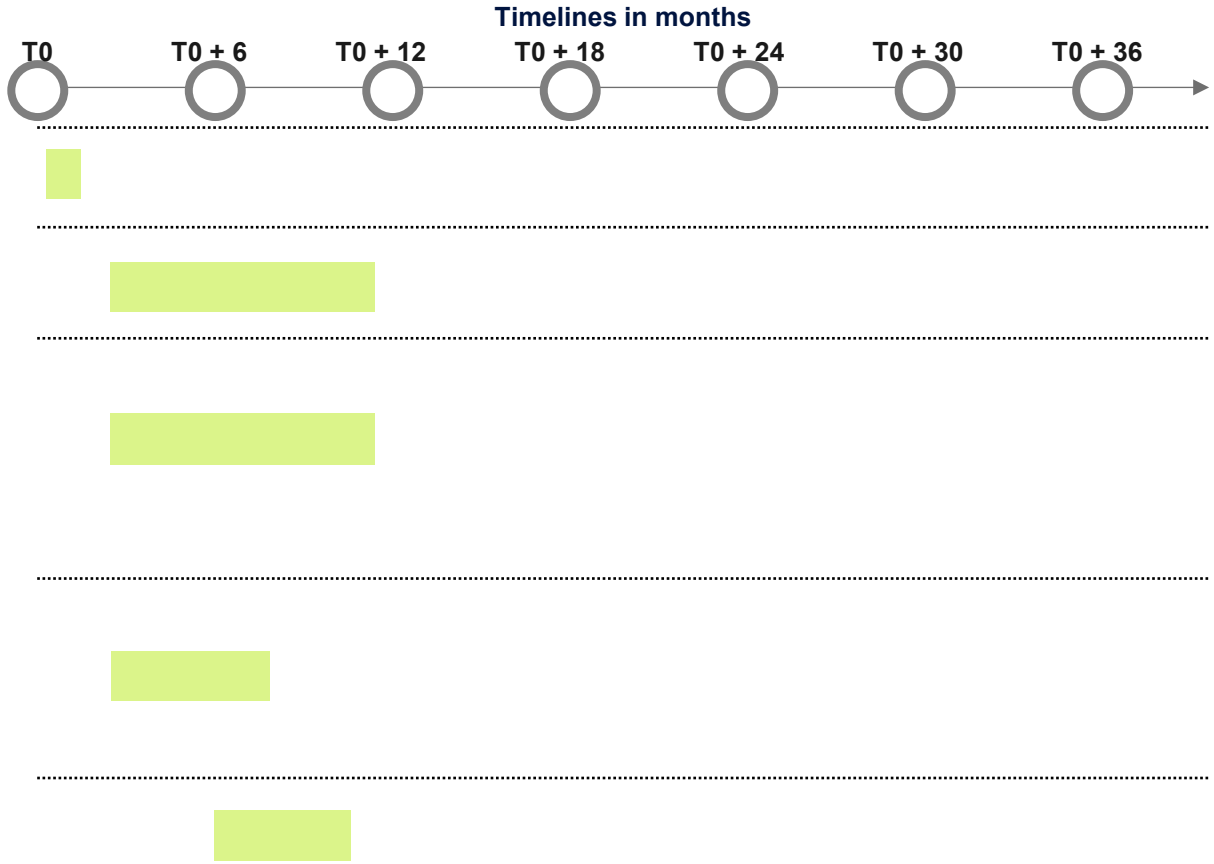
Workstreams	Activities
Build Cost-based price index for both GH2 and GNH3	- Identify cost components (CAPEX, OPEX) - Define key assumptions (Plant size, CUF, financing assumptions etc.) - Calculate LCOH and LCONH3
Build Survey-based market price discovery for both GH2 and GNH3	- Identify market participants (producers, off-takers, traders, exporters) for GH2 and GNH3 - Design survey framework (data points, frequency) - Assign weights to data inputs
Index methodology development	- Finalise index calculation formula for GH2 and GNH3 - Outlier removal mechanism and Liquidity filters - Regional adjustments
Governance & Validation	- Set-up index governance committee - Back testing
Price Index launch of GH2 and GNH3	- Publish index **of GH2 and GNH3**



Note: Definition
Source: mec+ analysis

Framework for setting up GH2/GNH3 trading model can be set-up in 12 months

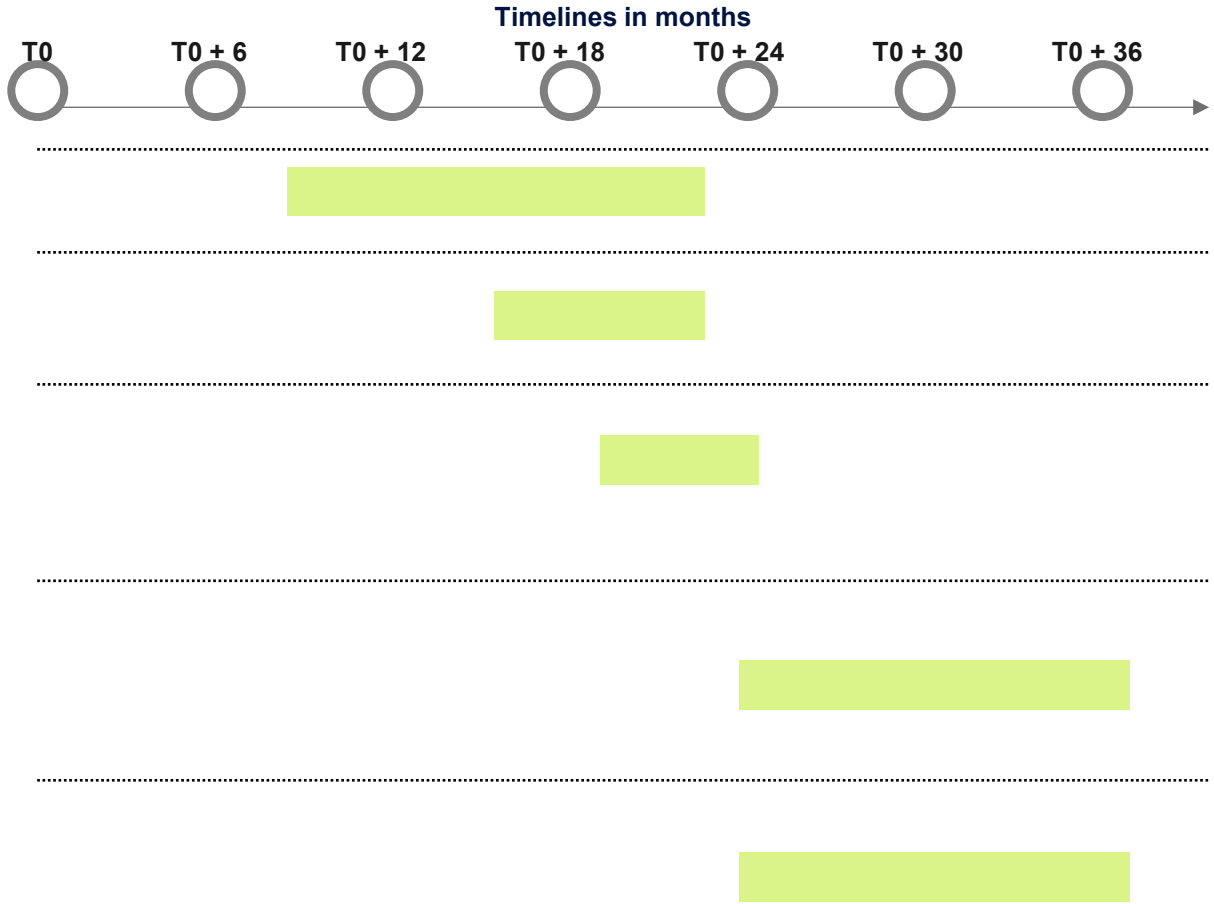
Workstreams	Activities
PROJECT INITIATION • Project mobilisation approved	- Pilot charter, scope, KPIs and budget baseline approved - Governance committees formally constituted - Programme management office setup
REGULATOY APPROVALS • Regulatory pathway agreed	- Regulatory engagement initiated with PNGRB, MNRE, BEE - Legal classification of the exchange (assessment to finalised) - Sandbox / NOC approval (initiated to received)
VERIFICATION ARCHITECTURE • Verifier empanelment • Verifier accreditation criteria published • PPA/REC-based verification protocol developed	- Draft product and contract scope and quality finalized as per MNRE - Establish Verification method : 8-12 third-party auditors - Publish verifier accreditation criteria: demonstrate H2 audit capability - PPA and REC integration for green; other mechanisms for water and additionality - Audit team SOPs, rules, fee established - Verifier framework contracts executed
PILOT • Participant & facility onboarding completed • Logistics & delivery protocol finalized • RFQ based pilot trading & Delivery validation completed	- Supplier, distributor and buyer onboarded - Distributor storage facility identification & assessment - Transport fleet readiness and safety certification - Distributor storage and handling compliance verification - Dispatch and delivery documentation procedures - RFQ trading framework setup - Pilot transactions execution & settlement process validation
DOCUMENTATION • Product & contract design finalized • Rulebook & standard contracts finalized • Performance review completed	- Technology architecture design completed - Clearing & settlement module development - Platform integration and system testing - Security testing and performance validation



Source: mec+ analysis

Launch and expansion of GH2 and GNH3 trading platform to export market & additional products can be taken up over next 24 months

Workstreams	Activities
TECHNOLOGY INFRA • Exchange technology platform build & Testing completed	- Technology architecture design completed - Clearing & settlement module development - Platform integration and system testing - Security testing and performance validation
Go-Live Phase 1 - Domestic MNRE Tier	- OTC launch preparation - Initial hub designation: Kandla, Paradip, Hazira, Tuticorin for physical delivery - Single-tier launch: MNRE-grade GH2
Tier Expansion	- CertifHy-equivalent book opened for export-production - Voluntary corporate book opened for RE100-equivalent standards - Water source, land-use, electrolyser technology attributes activated - Green ammonia product launched with embedded H2 attribute conversion
Registry Integration and Cross-Border	- Migration of private registry to BEE GHC registry when operational - Historical certificate grandfathering - Bilateral registry recognition negotiations: Japan METI, Korea MOTIE, EU Commission - Pilot India-EU corridor for ammonia trade with certificate recognition
Product Expansion	- Green methanol with carbon source attribute tagging - Green steel mass-balance certificates linked to ResponsibleSteel, SteelZeroSAF from GH2 with CORSIA eligibility verification - Blue H2 with CCUS as separate non-green tier



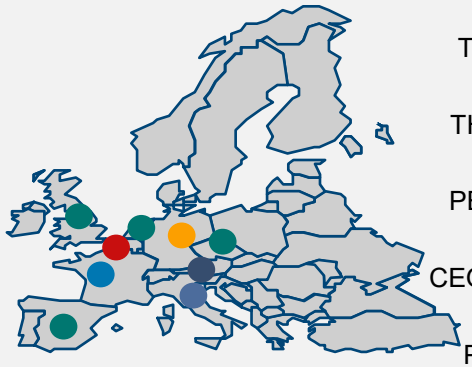
Note: Definition
Source: mec+ analysis

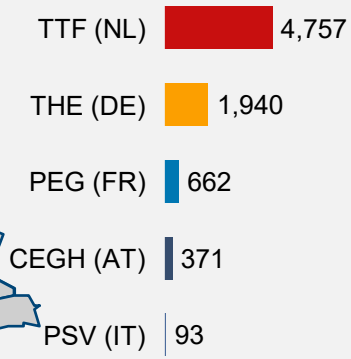
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8	Global case studies of trading platforms
9	Regulatory overview : State policies and certifications

Case Study - EU Natural gas exchange
European Natural Gas Trading Market is dominated by Derivatives Contracts and Chemical Sector Demand

Trading hub locations & volumes**
TWh, 2025

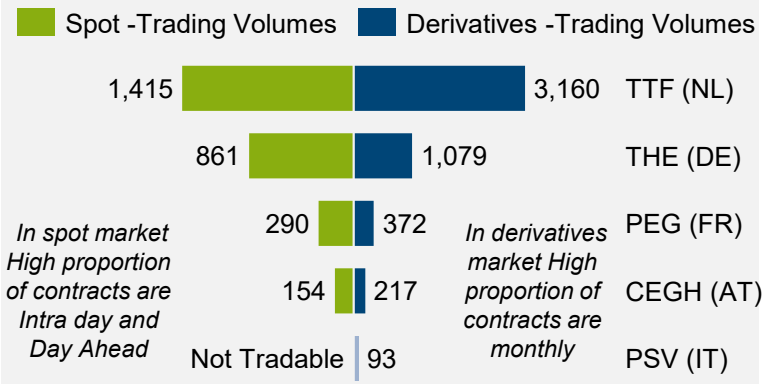




Price index & discovery mechanism***

Exchange	Index	Calculation	Mechanism
ICE	-	(Σ (price × quantity)) ÷ (Σ quantity)	Volume-Weighted Average
EEX	EGSI		Volume-Weighted Average
GME	IGI	(1/TOT) * Σ(Pt)	Volume-Weighted Average

Contract types & Volumes
TWh, 2025



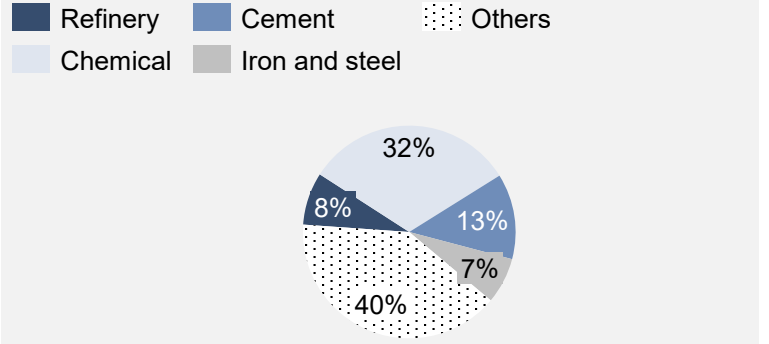
Evolution of trading hub

- 1996: NBP (National Balancing Point) launches as Europe's first virtual trading hub
- 2003: TTF (Title Transfer Facility) launches in Netherlands
- 2009: TTF quality conversion introduced; Third EU Gas Directive
- 2018: TTF overtakes NBP as Europe's premier hub

Key stakeholders

eex	EEX operates regulated spot and derivatives markets for European gas hubs like TTF
ICE	The Intercontinental Exchange (ICE) operates major natural gas futures and financial contracts for North America and Europe
TSOs	Infrastructure companies that operates the gas transmission network

Prominent Sectors by end users*

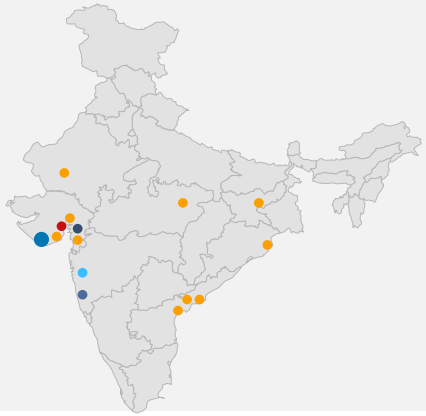


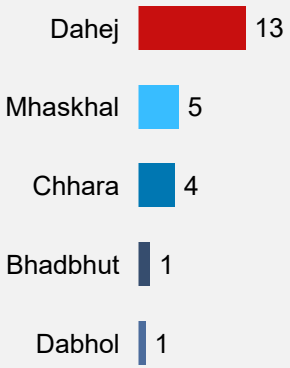
Note: *End users by sector as per 2021, Others include Food and beverages, papers and pulp manufacturing and others
** Others include countries Austria, Belgium, Spain, Czech republic, TTF= Title transfer facility, NBP= National Balancing Point, THE= Trading Hub Europe, PSV= Punto di Scambio Virtuale, TRF= Trading Region France ***TOT = Transaction concluded in that time period, Pt = Price of the t[illegible] transaction in that time period (17:15-17:30), Definitions
Source: Oxford institute of energy studies; EEX press releases; Center of global energy policy; mec+ analysis

Case Study - India gas exchange
In contrast Indian natural gas trading market is driven by spot contracts, with CGDs, marketers, and power plants as key demand players

Trading hub locations & volumes

Mn MMBTU, FY26 (Q1)





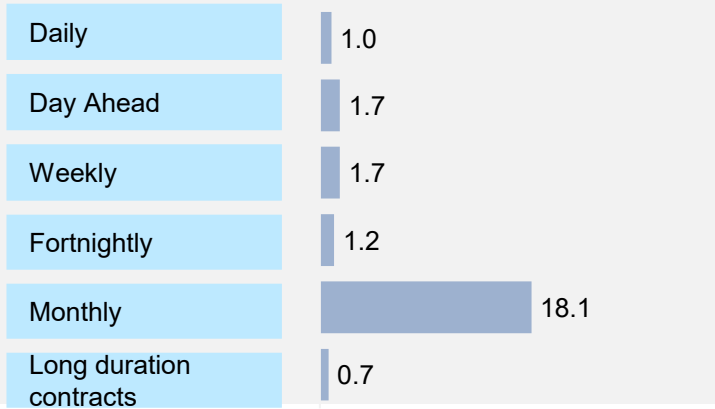
Price index & discovery mechanism

Exchange	Index	Calculation	Mechanism
IGX	GIXI (Gas Index of India)	(Σ (price × quantity)) ÷ (Σ quantity)	Volume-Weighted Average

Price Discovery- Double Sided Uniform Price Auction

Contract types & Volumes

Mn MMBTU, FY26 (Q1)



Evolution of trading hub

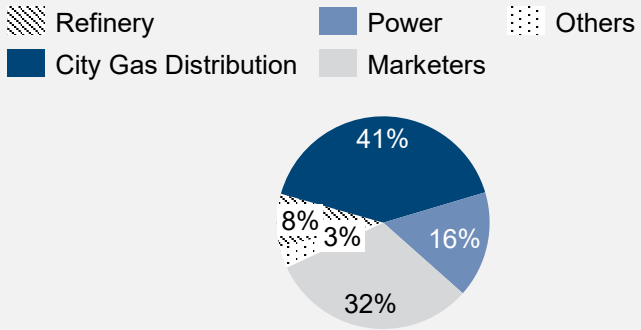
- Jun 2020- IGX started operating as a gas trading platform, Ministry of Petroleum and Natural Gas issued a policy directive authorizing PNGRB to regulate gas exchange(s)
- 2023: IGX introduced the Gas Index of India (GIXI), the country's first nationwide price index reflecting benchmark natural gas prices.
- 2025: IGX officially launched its first Long-Duration Contracts (LDCs) for 3-month and 6-month delivery periods

Key stakeholders

PNGRB — Provides regulatory oversight, issues authorizations, and ensures compliance with gas trading regulations

IGX — Facilitates gas trading, ensures neutral and transparent market operation, price discovery, contract settlement, and participant onboarding

Prominent Sectors by end users



Note: Definition

Case Study - EU Hydrogen trading
EEX and CEGH are two prominent exchanges that list green hydrogen; however, actual trading remains at a very nascent stage

Trading hub locations & volumes

TWh, 2025



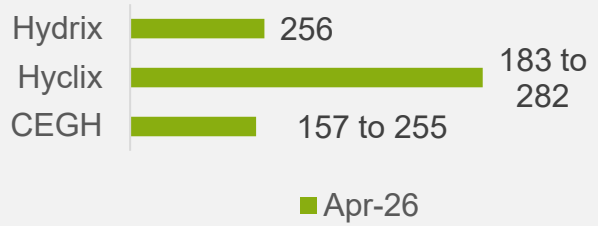
Green hydrogen trading volumes on European exchanges like CEGH and EEX are effectively zero in 2025, with markets still focused on pilot trades, certificates, and long-term contracts

Price index & discovery mechanism*

Exchange	Index	Calculation	Mechanism
CEGH	Green hydro gen index	Electricity + GoOs + CAPEX	
EEX	HYDRIX	$\emptyset Bid + \emptyset Ask / 2$	Arithmetic mean of reported values

Contract types & Volumes

Index prices in EUR per MWh for April 1, 2026



Evolution of trading hub

- 2018: Formation of the European Clean Hydrogen Alliance to promote collaboration and support
- 2023: Launch of Hydrix, Europe's decentralized green hydrogen marketplace and trading platform, enabling peer-to-peer (P2P) green hydrogen trading and certificates.
- 2024: Formal market mechanisms and auctions initiated for green hydrogen procurement through platforms like CEGH GreenGas and EEX

Key stakeholders

EEX operates the HYDRIX platform by managing price data collection, calculating the hydrogen price index, ensuring market transparency

CEGH operates the Green Gas Platform facilitating the buying and selling of green hydrogen across the EU and neighboring countries

Prominent Sectors by end users

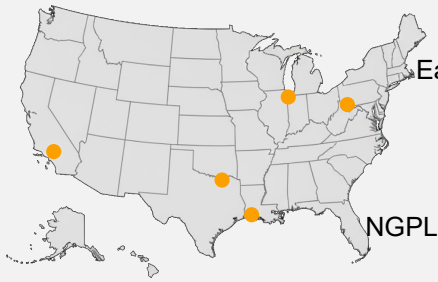
At present, there is no active trading of green hydrogen in the market

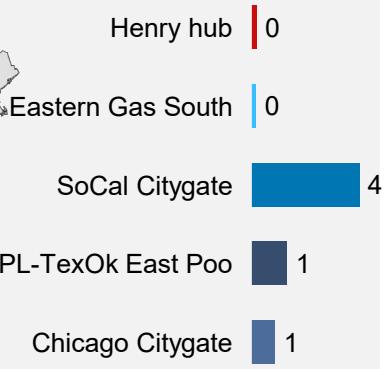
Note: *simple average of the average bid side and the average ask side Calculation is Electricity grid purchase cost + Guarantees of origin + CAPEX , Definition

Source: EEX HYDRIX price, Hyclix prices,CEGH green hydrogen indices report; mec+ analysis

Case Study - US Natural gas
In contrast US natural gas trading market is driven by spot contracts, with CGDs, marketers, and power plants as key demand players

Trading hub locations & volumes
Mn MMBTU, FY26 (Q1)

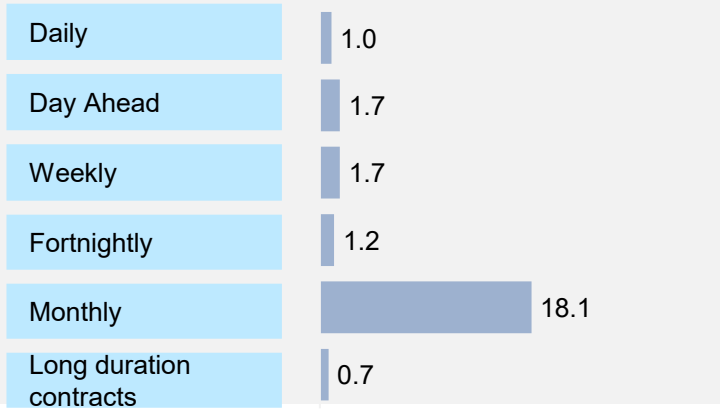




Price index & discovery mechanism

Exchange	Index	Calculation	Mechanism
CME group	S&P 500	$\frac{\sum=1nPi\times Qi}{\text{Divisor}}$	Free-Float Market Capitalization

Contract types & Volumes
Mn MMBTU, FY26 (Q1)



Evolution of trading hub

- 1990- NYMEX introduces Henry Hub natural gas features enabling hedging by producers, traders.
- 2005-2010: Lowering prices and driving development of new regional hubs like Waha Hub; market faces capacity constraints
- 2020-2025: Rapid LNG export growth, record trading volumes, and peak market liquidity made the US natural gas market the world's largest and most liquid

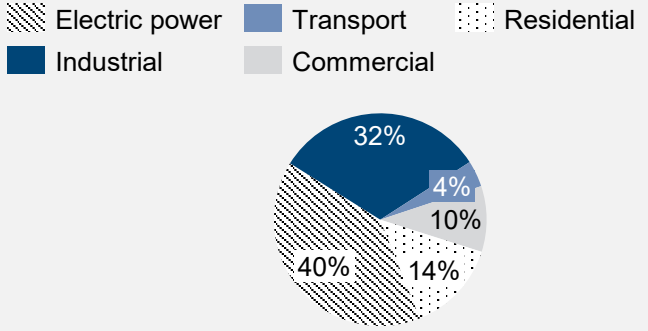
Key stakeholders

NYMEX — Provides regulatory oversight, issues authorizations, and ensures compliance with gas trading regulations

Regulates interstate pipeline transportation, storage, and LNG terminals to ensure just and reasonable rates

Oversees futures, options, and swaps markets, enforcing anti-manipulation and anti-fraud rules

Prominent Sectors by end users



Note: Definition
Source: IGX press release; Primary discussions with IGX; mec+ analysis

Case study - India International Bullion Exchange (IIBX): From Framework to Launch

About the exchange

Establishment: July 29, 2022

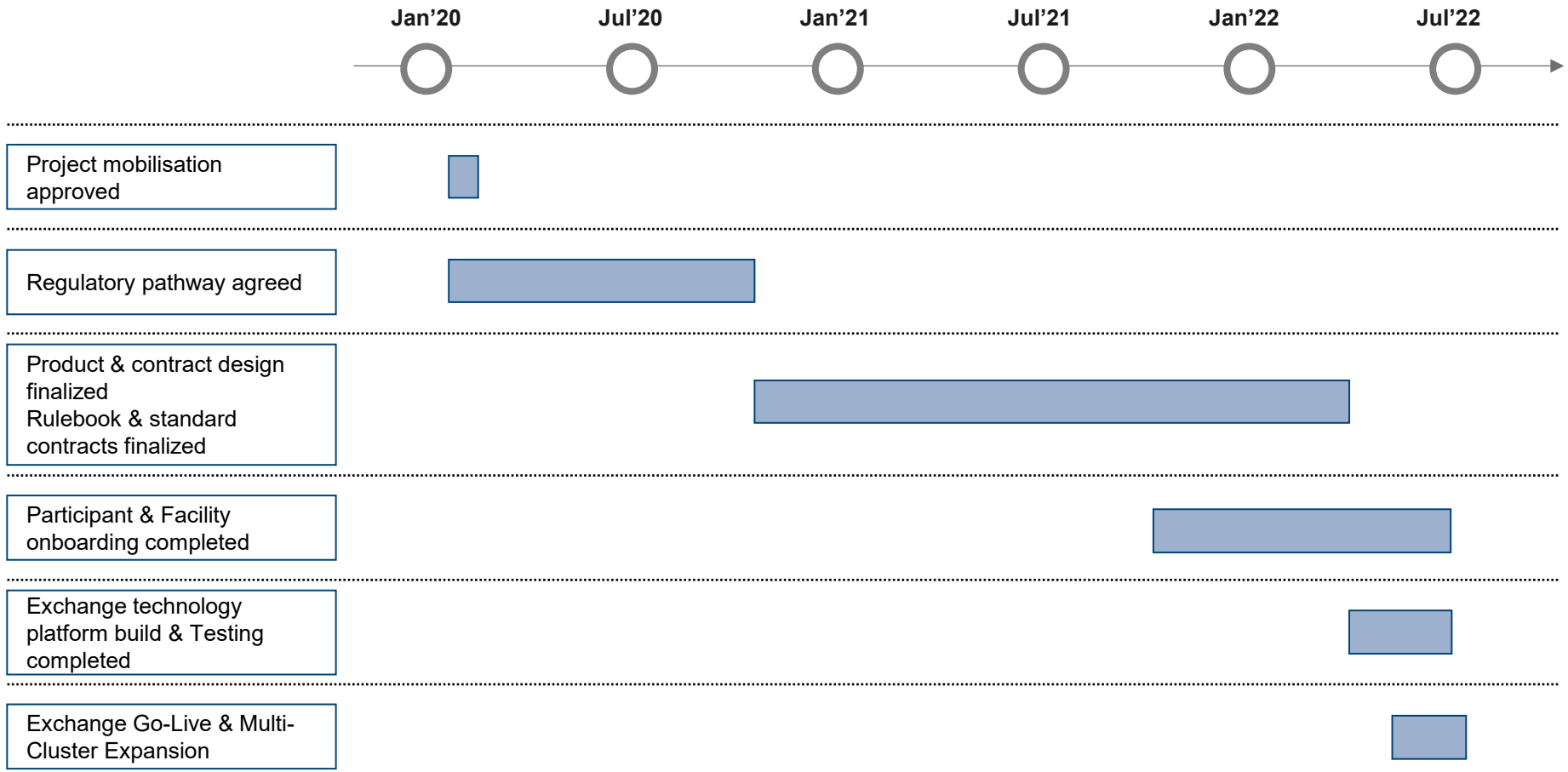
Purpose: Create a transparent price discovery mechanism for bullion, enable direct gold imports for jewelers, reduce reliance on international price benchmarks

Products Traded: Gold 995, Gold Mini 999, Silver

Participants: 64+ Qualified Jewelers; International Bullion Banks; Trading Members

Regulator: International Financial Services Centres Authority (IFSCA)

Volumes traded in FY 25: Gold volumes 93 MT and silvervolumes of 1150 MT



Note: Definition

Case study - NOREXECO, Norway : From Framework to Launch

About the exchange

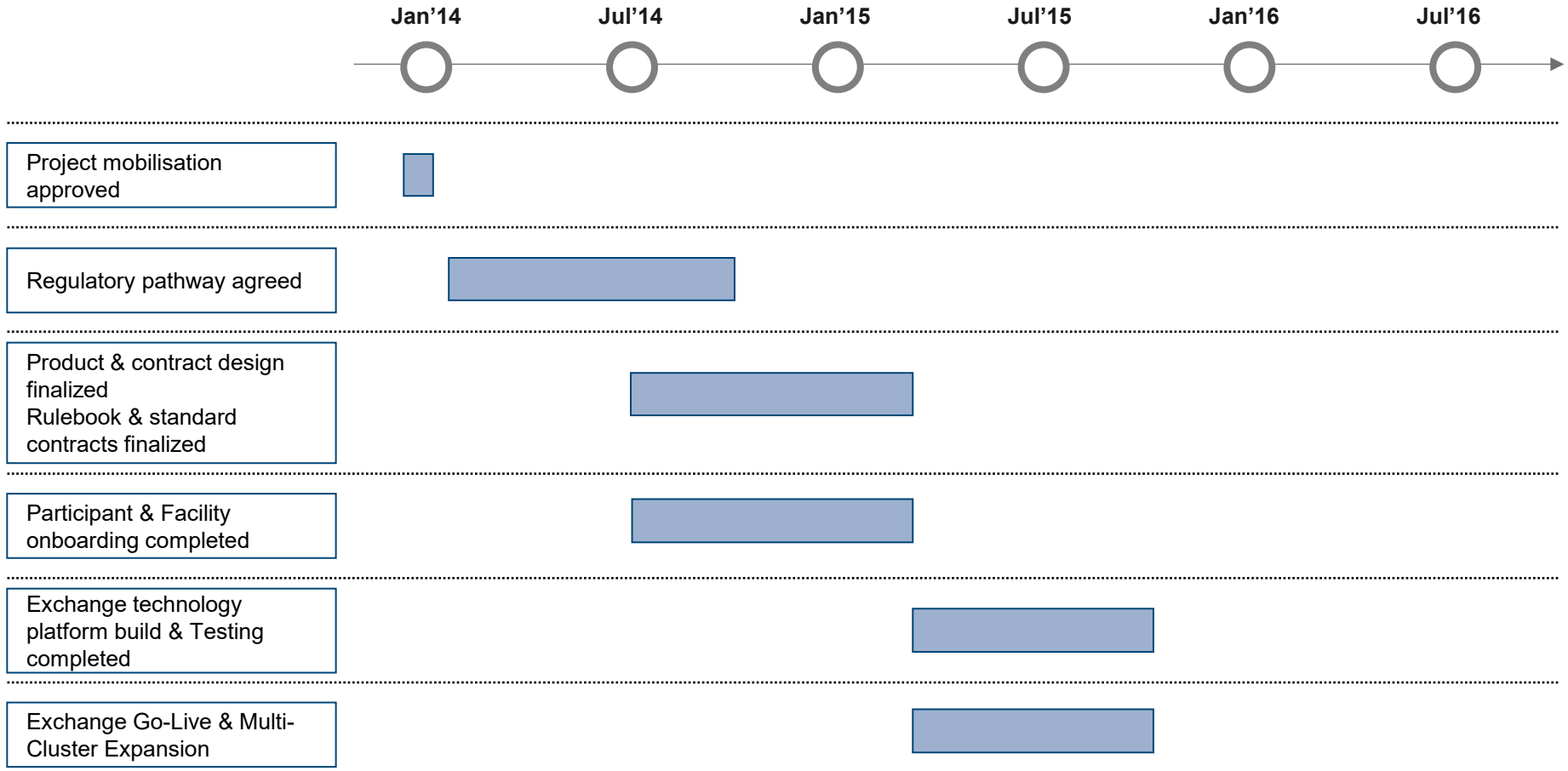
Establishment: 2015

Purpose: Provide a transparent and efficient marketplace for trading Nordic and European power-related derivatives, enabling price discovery and risk management

Products Traded: Nordic Power Futures, Nordic Power Options, Electricity Contracts for Difference

Participants: Power producers, utilities, energy trading firms, financial institutions, industrial power consumers

Regulator: Regulated under Norwegian financial market regulations and supervised by the Financial Supervisory Authority of Norway



Note: Definition

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9	**Regulatory overview : State policies and certifications**

State and central incentives | Complementing central measures, states have introduced similar supply-side incentives (I/II)

Level of incentives available across states with favourable policies

Not Available Available

Incentives Available	State RE/Industrial Policy			Policy Announced		
	KA	TN	OD	AP	GJ	Central
Target for GH2 and GNH3	NA	NA	NA	GH2 – 500 KTPA GNH3 – 2000 KTPA	GH2 – 3000	GH2 – 5000
Electrolyser Manufacturing Incentives			IPR 2022 thrust sector benefits applicable to electrolyser manufacturing	25% electrolyzer capex subsidy (upto to 1 Cr/MW)		**SIGHT Component I:** ₹4,440 crore outlay for domestic electrolyser manufacturing.
Hydrogen Asset Development			Rs 3/unit power tariff reimbursement for 20 yrs	25% CAPEX subsidy for Green Ammonia & green methanol facilities	20% CAPEX subsidy on : • Electrolyser upto 1 Cr per MW(for 10 MW cap), • BESS upto 18 lakh per MW • ₹35 crore per hub of >3KTPA	**SIGHT Component II** : ₹13,050 crore for green hydrogen production incentive
Technology Acquisition & Research & Development					₹50 crore budget for R&D and CoE	R&D outlay of INR 400 Cr under NGHM for hydrogen innovation, production routes, safety, storage, and utilization
Input Subsidies (exemptions- state transmission ,CSS, Wheeling)			For RE consumed, CSS & additional surcharges, & state transmission charges exempted for 20 years	50% Transmission charge exemption for 5 years	50% transmission & wheeling charge reimbursement	**100% ISTS charges waiver for 25 years** for green H2/NH3 projects commissioned on or before 31 Dec 2030
Investment Support (land subsidies, taxes, duty exemptions etc)	Capital subsidy up to 25%, PLI, stamp duty waiver	Up to 10–25% of FCI (zone-wise)	100% SGST reimbursement 100% exemption from payment of Electricity Duty for 20 years	100% stamp duty and land-use conversion charge exemption 100% SGST reimbursement & 100% electricity duty exemption	100% land registration & stamp duty reimbursement	**Single-window clearance** through MNRE portal

Source: AP Policy, GJ Policy, OD Policy , mec+ analysis

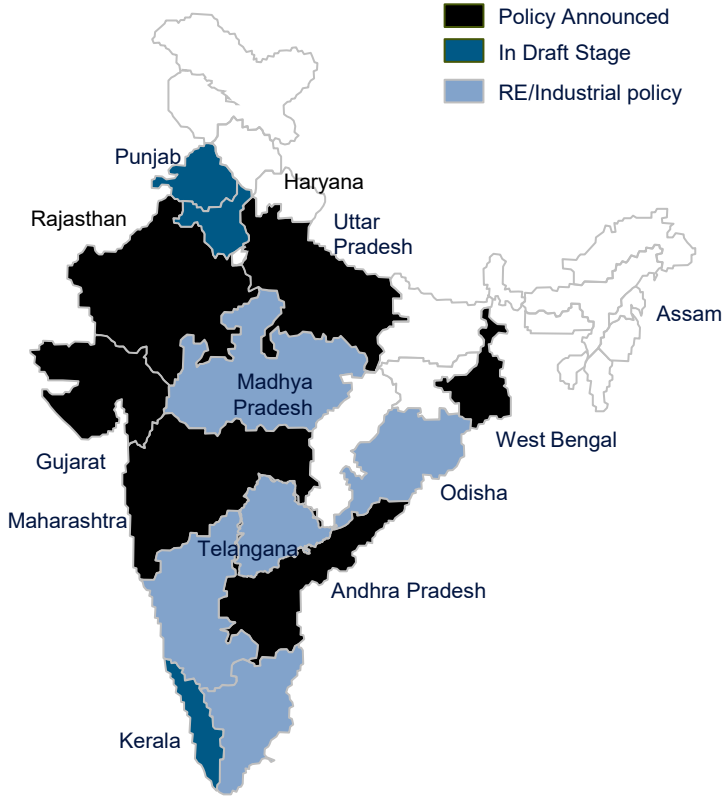
State and central incentives | Complementing central measures, states have introduced similar supply-side incentives (II/II)

Level of incentives available across states with favourable policies

Not Available Available

Incentives Available	Green Hydrogen Policy Draft			Policy Announced			
	HR	KL	PB	RJ	UP	MH	WB
Target (KTPA)	250	155	100	2000	1000	500	NA
Electrolyser Manufacturing Incentives							
Hydrogen Asset Development							
Technology Acquisition & Research & Development							
Input Subsidies (exemptions- state transmission ,CSS, Wheeling)							
Investment Support (land subsidies, taxes, duty exemptions etc)							
Policy Support	**Punjab –** • 100% electricity duty, Stamp duty exemptions • 50% exemption in Intra state transmission chargers			**Rajasthan –** • 50% Intra state transmission/wheeling **Uttar Pradesh –** • 100% waiver on wheeling, Transmission, CSS & electricity duties		**Maharashtra –** • 50% exemption on transmission/ wheeling charges, • Exemption on CSS and additional surcharges, • 100% Electricity duty exemption	

States with Hydrogen Policy



Source: HR, KL, PB, RJ, MH, UP,, mec+ analysis

Green hydrogen certification | Evaluating Import Certification Criteria for Indian Green Hydrogen (I/III)

Principal Divergences between GHCI, RFNBO, METI and Korean Clean Hydrogen Certification

Category	GHCI	RFNBO	METI Low-Carbon H2 Certification	Clean Hydrogen Certification
Definition	• Hydrogen produced from electrolysis of water using renewable energy (including grid-banked RE, banking, and offsetting via energy storage) or from biomass conversion	• Liquid or gaseous fuels whose energy content is derived from renewable sources other than biomass	• **Low carbon hydrogen:** hydrogen and its derivatives whose CO_2 emissions per unit are equal to or below a threshold	• **Clean H2**: H2 with GHG emissions ≤ 4 kg CO_2 eq/kg H_2, produced via one of four eligible pathways: water electrolysis with RE & nuclear electricity, gas reforming with ≥90% carbon capture, bio-waste gasification.
Feedstock / Scope	• Hydrogen from electrolysis driven by RE (including biomass derived electricity). Derivatives not covered yet; water-only electrolysis	• Hydrogen (and derivatives: ammonia, methanol, e-fuels) from RE only. Biomass and biogenic feedstocks explicitly excluded.	• H_2 + designated derivatives: NH_3, e-fuel, e-methane. Technology-agnostic (RE, nuclear, fossil + CCS).	• H_2 + derivatives. Multiple pathways: RE electrolysis, nuclear electrolysis, gas reforming with ≥90% CCS, bio-waste gasification.
Applicability to imports	• Applicable to H2 produced in India, audited by BEE-accredited ACV's, required for SIGHT subsidy access	• Same rules as EU RFNBO	• Imports judged on identical CI thresholds and JOGMEC Guideline methodology	• Same terms as domestic, imports are certified under identical threshold and four-tier grading, audited by MOTIE-designated certifying institutions
System Boundary	• Includes electrolysis → purification → compression → onsite storage. Excludes construction, transport, downstream conversion	• Well-to-dispatch: feedstock extraction, electrolysis, compression, transport to first delivery point, conversion to derivatives	• Well-to-gate for H_2 and NH_3; whole supply chain for e-fuels and e-methane	• Well-to-gate (feedstock extraction → hydrogen production)
Power Sourcing	• Any RE: direct, storage, grid banking, green tariff, G-DAM. No RE subsidy restriction. No temporal/geographical clauses	• Additionality: RE asset ≤ 36 months older; no RE subsidy (from 2028).Temporal: monthly match until 12-2029; hourly from 1-2030 (possibly 2035 delay).Geographical: same or interconnected bidding zone	• No additionality, temporal, or geographical correlation requirements. CI threshold is the only test.	• No additionality, temporal, or geographical correlation requirements. Pathway-based.
Verification Cadence	• Annual audit by BEE-accredited ACV; monthly data submissions; gate-only	• Annual audit by EU-recognised scheme; monthly data → hourly data (post-2030); full life-cycle	• Two-stage: METI + MLIT business plan approval, then JOGMEC ongoing CI verification across 15-year supply commitment.	• Annual certification by MOTIE-designated certifying institutions with post-certification inspections.
Certificate Types	• Concept → Facility → Provisional → Final (serials per 100 kg). Final required for subsidies	• Batch-level RFNBO certificates issued upon audit	• Business-plan-level certification under CfD scheme. 15-year subsidy + 10-year continued-supply obligation. No batch certificate	• Four-tier grading certificate; enables CHPS bidding market eligibility.

Note: Definition
Source: mec+ analysis

Green hydrogen certification | Evaluating Import Certification Criteria for Indian Green Hydrogen (I/III)

Power-Sourcing Comparison

Criterion	GHCI	RFNBO	METI Low-Carbon H2 Certification	Clean Hydrogen Certification
Additionality	• No additionality clause. Any RE asset, new or existing, qualifies, including those receiving Indian subsidies.	• RE plant commissioned ≤ 36 months before electrolyser. No operating or investment aid to RE (from 1 Jan 2028). Grandfathering for pre-2028 plants until 2037.	• No additionality clause. Asset age, subsidy status, commissioning date irrelevant.	• No additionality clause. Any qualifying pathway eligible regardless of RE asset vintage.
Temporal Correlation	• Monthly banking of RE allowed, in some regional cases even annually. No requirement for monthly or hourly matching.	• Monthly matching until 31 Dec 2029; hourly matching from 1 Jan 2030 (EU law), with a possible extension to 1 Jan 2035 under discussion.	• No temporal matching requirement. Aggregate basis	• No temporal matching requirement. Annual emissions basis.
Power Data Verification	• Hourly metering required but only monthly data uploaded for GHCI audits; no hourly check.	• Hourly SCADA logs from 2030, supplied to EU scheme auditor.	• No mandated time-resolution; granularity driven by emission-source materiality.	• No mandated time-resolved metering. Annual aggregate verified.
Geographical Correlation	• No bidding-zone requirement. Any RE drawn from India's national grid qualifies	• Electricity must originate in the same bidding zone or an interconnected zone with equal/higher wholesale price. Applicable to sub-areas inside and outside the EU.	• No bidding-zone requirement.	• No bidding-zone requirement. Pathway-based.
Permitted Proofs	• Direct supply, on- or off-site storage, grid banking, green tariff, power-exchange (G DAM) purchases. RECs & carbon credits are invalid.	• Direct line, co-located storage, PPA with matched GOs (Guarantees of Origin) or GROs (Guarantees of Regional Origin). No generic RECs.	• Primary measurement data preferred per JOGMEC: equipment-specific emission factors, MRV (gas sampling, IR imaging, drone/satellite).	• Pathway-specific evidence per KEEI: electrolysis RE documentation, nuclear contract, ≥90% CCS verification, bio-waste provenance.

Note: Definition
Source: mec+ analysis

Green hydrogen certification | Evaluating Import Certification Criteria for Indian Green Hydrogen (I/III)

GHG Methodology Comparison

Aspect	GHCI	RFNBO	METI Low-Carbon H2 Certification	Clean Hydrogen Certification
Reference Standard	• ISO 19870:2023 + ISO 14064; uses CEA grid factors for electricity, specific feedstock factors.	• Annex I of Reg 2023/1185; uses JRC default factors and EU fossil comparator.	• JOGMEC GHG/CI Guideline v2 (June 2023); ISO 14064, GHG Protocol, IPIECA, OGMP 2.0 aligned.	• KEEI GHG accounting methodology under MOTIE Operation Plan; pathway-specific (electrolysis, reforming + CCS, bio-waste)
GHG Threshold	• ≤ 2.0 kg CO_2/kg H_2 (LHV) (12-month average).	• ≥ 70 % savings vs fossil (91 g CO_2/MJ) ⇒ ≤ 3.38 kg CO_2/kg H_2 (LHV).	• ≤ 3.4 kg-CO_2e/kg-H_2 (well-to-gate). NH_3 ≤ 0.87 kg/kg. e-Fuel ≤ 39.9 g/MJ. e-Methane ≤ 49.3 g/MJ.	• Annual basis with tier grading. Not batch-based.
Functional Unit / Averaging	• 12-month rolling average for entire facility. Certificates cover annual performance.	• Batch-by-batch; GHG saving verified for each lot. No averaging.	• Aggregate emissions per supply volume. Not batch-based.	• Well-to-gate; construction and downstream transport excluded.
System Boundary	• Well-to-gate: covers electrolysis, purification, compression, onsite storage. Excludes construction, offsite storage, transport, conversions.	• Well-to-dispatch: includes feedstock extraction, electrolysis, compression, transport to first delivery point, downstream conversion to e-derivatives.	• Well-to-gate for H_2 and NH_3; whole supply chain for e-fuels and e-methane. Construction excluded.	• Specific numeric thresholds not published
Electricity Emission Factor	• CEA grid average factor (updated quarterly), plus standard transmission loss multiplier.	• Hourly residual mix or site-specific factor approved by auditors; JRC default factors exist.	• Primary data preferred; equipment-specific emission factors based on measurement. IPCC AR5 GWP.	• Korean grid average for grid-electrolysis
Materiality Threshold	• < 1 % per source; ≤ 5 % total excluded	• < 1 % per source; ≤ 10 % total emissions can be excluded	• No codified numeric ceiling	• Specific numeric thresholds not published in English primary
Co-Product Allocation	• Same energy-content allocation for oxygen, heat.	• Energy-content method for oxygen, e-heat, derivatives.	• Energy-content allocation is JOGMEC-recommended	• Allocation per KEEI framework
Verification	• Annual audit by BEE accredited ACV; Final Certificate issued each FY (April to March).	• Annual audit (calendar year) by EU-recognised voluntary scheme (CertifHy, ISCC EU, REDcert H2).	• METI + MLIT approve business plan; JOGMEC verifies ongoing emissions per CI Guideline.	• MOTIE-designated certifying institutions per Hydrogen Act Article 25-2

Note: Definition
Source: mec+ analysis

Stakeholder Feedback Questionnaire - Comprehensive Study for Developing India's Green Hydrogen Market & Trading Framework

INSTRUCTIONS

To participate,

1. Open the URL provided or scan the QR code.
2. Enter your name, company name, designation, and email address.
3. Answer the multiple-choice questions based on your experience and understanding of the project

Click here to participate

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The International Hydrogen Ramp-up Programme (H2Uppp) of the German Federal Ministry for Economic Affairs and Energy (BMWE) promotes projects and market development for green hydrogen in selected developing and emerging countries as part of the National Hydrogen Strategy.