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Charith Konda || Energy Specialist, IEEFA
Kaira Rakheja || Energy Analyst, IEEFA

Enabling sustainable demand for green hydrogen in India

- *As of August 2025, India had 158 green hydrogen projects at various stages of development. However, 94% of the planned capacity is yet to move beyond the announcement stage, 0.1% is under construction, and only 2.8% is operational, highlighting the slow pace of project commissioning.*
- *The primary barriers include a lack of committed buyers (i.e., unclear demand signals), high production costs, varying definitions of green hydrogen, and inadequate infrastructure—particularly for storage, transportation, and shared facilities.*
- *According to industry estimates, India's total hydrogen demand could reach 15–20 million metric tonnes per annum (MMTPA) by 2030. Green hydrogen demand could reach 4.08-6.57MMTPA if supportive policies are adopted to drive new sectoral applications in steel, transportation, chemicals, and exports.*
- *Setting a globally accepted emissions accounting framework, introducing hydrogen purchase obligations, utilising demand aggregation, and developing hydrogen hubs with shared infrastructure are crucial to scaling up demand and accelerating project commissioning.*

Introduction

India's immediate climate goals are tied to its long-term target of achieving net-zero emissions by 2070. In the short term, India aims to achieve 50% of its installed power generation capacity from non-fossil fuel sources by 2030 and reduce its emissions intensity below 45% by 2030 from 2005 levels. To advance these objectives, the government has launched several key initiatives focusing on promoting renewable energy, enhancing energy security, and reducing carbon emissions.

One such initiative is the National Green Hydrogen Mission (NGHM), launched by the government in January 2023. The NGHM aims to make India a global hub for the production, use, and export of green hydrogen and its derivatives (which are produced through electrolysis of water using renewable electricity), with an outlay of INR197 billion (USD2.2 billion). The mission aims to facilitate the production of five million metric tonnes per annum (MMTPA) of green hydrogen by 2030, at an estimated investment of over INR8 trillion (USD90.5 billion).

Currently, India imports over 40% of its primary energy requirements, valued at approximately INR7.9 trillion (USD90 billion) annually. As a clean, sustainable, versatile fuel and a chemical feedstock, green hydrogen has the potential to decarbonise hard-to-abate industries and drive new sustainable applications in sectors such as fertiliser manufacturing, shipping, and aviation. The NGHM is also a strategic lever for energy security, with an estimated potential to reduce fossil fuel imports by INR1 trillion (USD11.27 billion) by 2030. However, green hydrogen production will require a continuous supply of clean power, and producing 5MMTPA of green hydrogen will necessitate the installation of approximately 125GW of additional renewable power capacity by 2030.

Many projects are in the early stages

According to the Ministry of New and Renewable Energy's (MNRE) green hydrogen database, there were 158 green hydrogen projects at various stages of development as of August 2025. Approximately 94% (~11.2MMTPA) of the total green hydrogen capacity has been announced, with other details yet to be finalised. Approximately 0.1% (9,770TPA) is under construction, and 2.8% (0.3 MMTPA) was operational as of August 2025, reflecting the industry's relatively early stage of development **(Table 1)**. Although the announced capacity is nearly 2.4 times the government's target—reflecting strong investor interest in India's green hydrogen story—there are concerns about how much of this capacity will materialise, given the challenges outlined in the next section.

Table 1: Status of green hydrogen projects, August 2025

Project status	Number of projects	Green hydrogen production capacity (tonnes per annum)	Share of total capacity (%)
Announced	134	11,172,698	94.0
Planned	4	374,165	3.1
Decommissioned	1	-	0.0
Under construction	7	9,770	0.1
Operational	12	335,080	2.8
Total	**158**	**11,891,712**	**100.0**

Source: MNRE, IEEFA

The proposed projects in India have a wide range of end-use applications, underscoring the versatility of green hydrogen in decarbonising multiple sectors. Major applications include the use of green hydrogen in oil refining processes and fertiliser manufacturing, complemented by projects that involve blending with natural gas in city gas distribution, and other industrial uses, such as chemicals and mobility.

> **"Although the announced capacity is nearly 2.4x the government's 2030 target, only 2.8% of the total capacity in the pipeline is operational, and about 0.1% was under construction as of August 2025.**

While green hydrogen is a promising fuel for decarbonising several sectors, the industry is facing headwinds in several countries due to high production costs, demand uncertainty, and inadequate infrastructure. Even though India has not witnessed any significant cancellations of green hydrogen projects to date, unlike in the US, Europe, or Australia, the large number of projects in the very early stages of development underscores the importance of easing project execution challenges.

Challenges to green hydrogen uptake

The green hydrogen industry faces several challenges that hinder its adoption. These include comparatively high production costs, demand uncertainty, lack of regulatory clarity, and gaps in supporting infrastructure that deter investors. Currently, captive projects (e.g., oil refining) and those with a guaranteed offtake (e.g., fertiliser manufacturing) are being commissioned.

Demand uncertainty

One of the primary concerns for investors of green hydrogen projects globally is securing a reliable and bulk buyer for green hydrogen. According to Bloomberg data, by January 2025, only 6% of the world's planned green hydrogen capacity had a buyer/offtaker lined up. This means around 212 million tonnes (94%) worth of global capacity in the planning stages was without an offtaker.

The lack of an anchor buyer leads to delays in securing financing and making final investment decisions for green hydrogen projects. Given that most planned projects in India are in the early stages of development, many could struggle to achieve financial closure if they fail to secure a buyer. Potential buyers are wary about the high cost of green hydrogen and the inadequate infrastructure.

While the NGHM sets a target of producing 5MMTPA of green hydrogen by 2030, it does not establish purchase obligations for existing hydrogen users or potential users. Although various incentives support supply, demand is expected to be driven by individual user initiatives and high-level climate goals, such as economy-wide emissions reduction targets, making it a challenge.

High production cost

Grey hydrogen, produced from natural gas via steam methane reforming, is the conventional form of hydrogen that policymakers aim to replace with cleaner green hydrogen. The price of grey hydrogen is currently lower than that of green hydrogen (~USD1.5–3/kg vs USD3–6/kg, in general) because it is produced using mature technology and has well-developed infrastructure.

Meanwhile, green hydrogen prices are primarily determined by the costs of renewable energy generation and transmission, along with electrolyser costs. India benefits from low solar tariffs (INR2.5–3/kWh; USD0.028–0.034), which helps keep its green hydrogen costs below EU-imported levels of INR500–600/kg (USD5.6–6.8). Yet, even with this advantage, domestic green hydrogen remains costlier than grey. Electrolysers add another layer of expense, with current costs ranging from INR26,500–106,000/kW (USD300–1,200/kW) depending on the technology type, scale, and region.

In June 2025, India took an important step towards discovering a benchmark price for green hydrogen through the Indian Oil Corporation's auction for procuring 10,000TPA under a 25-year offtake agreement. The discovered price at INR397/kg (USD4.67/kg) is one of the lowest in the world, comparable to prices in the Middle East. However, the price may not be fully representative of green hydrogen prices across India, as the Indian Oil tender is particularly well-structured with long-term offtake agreements and large-scale operations.

Nevertheless, the price discovered is higher compared to the price of grey hydrogen. This green premium also makes green hydrogen commercially unattractive for industries such as refineries and fertilisers, which are already locked into cheaper grey hydrogen. Until cost competitiveness is achieved, investment and offtake will remain limited, restricting the development of a robust green hydrogen market.

Differences in green/low-emission hydrogen definition

Countries worldwide are defining what constitutes green or low-emission hydrogen in various ways. Definitions determine the disbursements of incentives and will eventually determine the prices of green hydrogen as well. Evolving definitions are also affecting the development of green hydrogen as a globally tradeable commodity.

Countries and regions have developed green hydrogen certification frameworks with varying levels of stringency, particularly in terms of emissions thresholds, the sourcing of clean energy, and technology specifications. In **Table 2**, we compare the green hydrogen standards set by India with those set by the EU and the US.

Table 2: A comparison of green hydrogen standards

Feature	Green Hydrogen Certification Scheme of India (GHCI)	EU (Renewable Fuels of Non-Biological Origin - RFNBO)	US (Inflation Reduction Act – 45V Tax Credit)
Carbon intensity requirement	≤ 2kg CO_2e/kg H_2	≤3.38kg CO_2/kg H_2	Emissions-based tiers for tax credits. Maximum 4kg CO_2e/kg H_2. Full tax credit: < 0.45kg CO_2e
Temporal matching	Not specified	Yes—requires temporal matching of renewable energy generation and hydrogen production. Monthly matching until 2029. Hourly matching from 2030.	Yes—annual matching to start with, and hourly matching by 2030.
Additionality	Not required—can source renewable electricity from both existing and new plants.	Yes (by 2028). Requires co-location of a renewable energy plant or Power Purchase Agreement with a newly built renewable energy plant.	Yes—clean electricity must be sourced from newly built renewable energy plants.
Geographic matching	Not specified as India has a unified national grid.	Yes—the renewable energy plant should be in the same bidding zone as the electrolyser.	Yes—the renewable energy plant should be in the same grid region as the electrolyser.
Technology neutrality	Electrolysis and biomass pathways supported	Electrolysis-only, strictly renewables (biomass, carbon capture storage, fossil steam methane reforming routes excluded by RFNBO definition).	All green hydrogen production pathways can qualify if they meet the required emission norms.

Source: IEEFA Analysis, MNRE, GoI; U.S. Treasury, European Parliament, Guillotin A. et al 2025, EnergyTag

Differences in the definitions and standards of green hydrogen are leading to market fragmentation due to variations in the green credentials of green hydrogen produced in different countries. This narrows down the potential of green hydrogen as a global commodity unless a globally acceptable emissions accounting framework and tracking are developed. In India, where both export-oriented and domestic green hydrogen projects are being developed, hydrogen with different green attributes may be produced, leading to challenges in utilising common infrastructure, such as pipelines and storage tanks.

> **"Strong offtake arrangements, continued financial support, regulatory certainty, and supporting infrastructure are essential to sustain demand for green hydrogen.**

Infrastructure challenges

Green hydrogen's ability to serve as a versatile fuel and a facilitator of decarbonisation in hard-to-abate sectors depends on the development of infrastructure, including electricity transmission and distribution grids, electrolysers, storage tanks, and pipelines.

In India, it is easier to transmit electricity rather than hydrogen, given that the country already has a well-spread-out transmission and distribution grid. Additionally, green hydrogen producers can also take advantage of transmission charge waivers available for transmitting renewable power used in the production of green hydrogen.

However, an emerging problem is the transmission interconnection delays for new renewable energy capacities in some renewable energy-rich states. Land acquisition also remains challenging in India due to poor land records and small landholdings.

In addition, applications in oil refining, fertilisers, and chemical and other industrial sectors, where hydrogen is a feedstock, will require hydrogen storage and transportation infrastructure, which includes cryogenic tanks, high-pressure cylinders, and pipelines. The costs of hydrogen distribution and storage can increase by three times the production cost when developed and utilised for individual projects, highlighting the importance of developing common infrastructure via hubs.

Further up the value chain, the lack of adequate domestic electrolyser manufacturing capacity is also a concern, as the uptake of green hydrogen could lead to an import dependency in electrolysers. To achieve the target of producing 5MMTPA of green hydrogen, India would require an electrolyser installed capacity in the range of 60–100GW by 2030. However, by August 2025, India had awarded only 3GW of electrolyser manufacturing capacity, leaving a considerable distance to cover to achieve self-sufficiency in electrolyser manufacturing.

The combination of these challenges is delaying the commissioning of green hydrogen projects in India. Hydrogen-specific infrastructure, particularly in standard or shared formats, is necessary to connect hydrogen production sites to consumption points.

Demand drivers for green hydrogen

India has a healthy pipeline of green hydrogen projects, although they are still in the early stages of development. The challenges discussed above need to be overcome for these projects to materialise. Creating visible demand across sectors will aid in green hydrogen supply chain development by securing investor confidence and long-term offtake.

In this section, we highlight some immediate demand drivers for green hydrogen that can be realised through policy measures, including hydrogen purchase obligations (HPOs) and sector-specific emissions reduction targets.

The demand for green hydrogen and its derivatives is expected to come from three sources: replacing existing grey hydrogen uses, new applications in hard-to-abate sectors, and exports. According to government estimates, replacing the full grey hydrogen current demand in oil refining and the manufacturing of fertilisers could result in a demand of 5MMTPA.

According to a December 2024 report by SBI Caps, India's total hydrogen demand is expected to reach 15–20MMTPA by 2029–30, up from 5–7MMTPA in 2024, representing a threefold increase **(Table 3)**. Currently, this demand is primarily met by grey hydrogen. Hence, the government's target of producing 5MMTPA of green hydrogen by 2030 is expected to account for 25–33% of the total hydrogen demand. Industry estimates for green hydrogen demand range between a low of 4.08MMTPA and a high of 6.57MMTPA by 2030 (Table 3). Depending on the implementation of support policies, the share of green hydrogen in total hydrogen demand could exceed 33%, driven by new demand from sectors such as steel, transportation, ammonia production, and exports.

Table 3: India green hydrogen demand scenarios, 2030 (MMTPA)

Sector	Base case with minimum interventions (2030)	Mature case with green hydrogen prices falling by ~50% (2030)	Green hydrogen potential market (2030)^
Oil refining	0.50	2.00	3.30–4.40
Fertilisers/ammonia	0.25	0.90	7.80–10.40
Blending with PNG	0.05	0.10	-
Steel	0.40	0.60	-
Chemicals, glass, and ceramics	0.04	0.07	1.95–2.60
Transportation*	1.35	1.80	1.35–1.80
Aviation	0.74#	-	
Exports	0.75	1.10	10
Total	**4.08**	**6.57**	**Addressable market:** Domestic: 15–20 Exports: 100

Sources: Govt. of India, NITI, Bain & Company, CII, RMI, SBI Caps, EY, IEEFA Analysis
**Long-distance trucking and shipping*
^Derived from the highest industry or government estimate
#With 2% blending of Sustainable Aviation Fuel (SAF) with conventional Aviation Turbine Fuel (ATF)

> **"With continued policy support, expected cost reductions, and steady infrastructure development, green hydrogen demand in India could range from 4–6.57 MMTPA by 2030, according to industry estimates.**

However, to meet the green hydrogen production goal, targeted measures are needed to generate the required demand to absorb the produced green hydrogen. These measures could drive the demand for green hydrogen until it is competitively priced with grey hydrogen. Green hydrogen is a versatile fuel with several potential end-use applications. Some use cases are readily accessible with a marginal increase in costs, while others may require infrastructure buildout, cost reduction, and compliance with mandates.

According to Bain et al., replacing a portion of grey hydrogen (blending) in existing uses, such as oil refining, fertiliser manufacturing, and piped natural gas (PNG), can provide the required initial acceleration in demand of approximately 0.80MMTPA by 2030. This demand can increase to 3MMTPA in a mature scenario, where the price of green hydrogen falls to USD2.5–3 per kg by 2030 **(Table 3)**.

Oil refining

Hydrogen is a crucial feedstock in oil refining to improve the quality and reduce the sulphur content of petroleum products, such as gasoline, diesel, and jet fuel. Traditionally, grey hydrogen is used in oil refining, which is extracted from natural gas through the steam methane reforming process. However, this process generates carbon emissions, which must be captured, stored, or utilised in other methods, such as enhanced oil recovery or industrial processes, to meet emission reduction goals. These methods are yet to be proven commercially.

The oil refining sector is an energy- and emissions-intensive industrial sector that is obligated to meet specific greenhouse gas (GHG) emission intensity targets under the upcoming Indian Carbon Credit Trading Scheme (CCTS). One way the oil refining sector can lower its emissions is by replacing grey hydrogen with green hydrogen. A 10% blending of green hydrogen in refinery operations could result in a demand of about 0.5MMTPA by 2030 **(Table 3)**. As per Bain et al.'s estimates, a 50% decrease in green hydrogen costs could make blending up to 40% viable, leading to a green hydrogen demand from oil refining operations of approximately 2MMTPA by 2030.

Fertiliser

The fertiliser industry consumes hydrogen in the form of ammonia, making it an immediate demand driver for green hydrogen in India. According to the SBI Caps report, it currently consumes 3.0–4.2MMTPA of hydrogen for fertiliser manufacturing, accounting for about 50–60% of hydrogen demand. The fertiliser industry contributes to GHG emissions (~1% of the total emissions) through carbon and methane emissions from the high energy requirements and chemical processes involved in the manufacturing of nitrogen fertilisers.

India has one of the largest fertiliser manufacturing capacities in the world. Blending of green hydrogen with conventional grey hydrogen in the fertiliser manufacturing process could create immediate demand for green hydrogen. According to Bain et al., a 5% blending of green hydrogen could yield a demand of 0.23–0.25MMTPA from the fertiliser industry by 2030 **(Table 3)**. An increase in blending to 20%, facilitated by a decrease in green hydrogen prices, could further increase the demand to 0.9MMTPA.

One of the main challenges to adopting green hydrogen in the fertiliser industry is the heavy government subsidy on fertilisers. Subsidies are directed at making fertilisers affordable to farmers, but also tie fertiliser prices to government decisions on subsidies, pricing controls, and import/export regulations. The blending of green hydrogen could increase the prices of fertilisers, thereby increasing the government's subsidy burden. However, it will lower the import bill as fertilisers are increasingly being produced using imported LNG.

Nevertheless, green ammonia auctions under the SIGHT program in 2025 (in the seven auctions held from 29 July until 18 August 2025 for a total of 460,000TPA production of green ammonia) have yielded encouraging results with prices ranging from INR50.75–55.75 per kg (USD579–641 per tonne). The quantity-weighted average discovered price of USD601 per tonne of green ammonia is approximately 31% higher than the average grey ammonia prices, which were in the range of USD400–515 per tonne this year. Before these auctions, green ammonia prices were expected to be in the range of USD707–715, nearly twice the price of grey ammonia.

The quantity-weighted average green ammonia price (USD601 per tonne) in India, discovered in these auctions, is approximately 48% lower (although not directly comparable) than the green ammonia price in the H2Global auction for importing green ammonia into Germany from Egypt. While some experts are viewing the lower discovered prices as a sign of India's growing competitiveness, others are raising concerns about project viability at these levels, as developers are still undergoing significant operational learning in managing technology, supply chains, safety, and regulatory risks.

Nevertheless, green hydrogen in the form of green ammonia will not only aid in decarbonising a hard-to-abate sector, such as the fertiliser sector, but also enhance the potential for exports. Green ammonia is relatively easier to export than green hydrogen due to its favourable physical and chemical properties, as well as the existing export and import infrastructure for ammonia.

Blending with natural gas

Blending green hydrogen with natural gas in either PNG or Compressed Natural Gas (CNG) is another application that can drive immediate demand for green hydrogen. Blending will not only lower India's dependence on scarce natural gas but will also lower GHG emissions. India imports half of its natural gas requirement annually in the form of Liquefied Natural Gas (LNG).

Studies and pilot projects conducted by Engineers India Limited, the Petroleum and Natural Gas Regulatory Board, and the National Thermal Power Corporation (NTPC) indicate that blending with PNG up to 10% is feasible without any equipment modifications, and blending of 15–20% or more with PNG is feasible with some equipment upgrades.

A 5% blending with PNG can generate a demand of 0.05MMTPA, and increasing the blend to 10% can result in a demand of about 0.1MMTPA by 2030 **(Table 3)**. Bain et al.'s estimates indicate that blending green hydrogen at 5% will increase the price of PNG by approximately 2% for the end consumer.

PNG users are highly price-sensitive, and the sector may struggle to afford higher blends of green hydrogen unless the price of green hydrogen drastically reduces.

Steel

The use of green hydrogen in steel manufacturing is emerging as another use case to drive industrial decarbonisation and meet international climate mandates for steel exports. The steel industry accounts for about 7% of global CO_2 emissions and is a crucial sector for decarbonisation.

In FY2024, India exported 7.5 million tonnes of steel, of which 3.3 million tonnes were to Europe—primarily to Italy, Belgium, and Spain. Exports to Europe accounted for 44% of total steel exports from India, indicating the importance of Europe for the sector. In addition to emerging tariffs and trade agreement issues, the EU's Carbon Border Adjustment Mechanism (CBAM)—a tax on carbon emissions embedded in imported goods—is likely to affect India's steel exports from 2026.

Green hydrogen can be integrated into the steel manufacturing process at various stages, including agglomeration, blast furnace operations, Direct Reduced Iron (DRI) processes, and downstream activities like reheating and galvanising. Two popular applications of green hydrogen in steelmaking are: the DRI paired with an Electric Arc Furnace (DRI-EAF) and the Blast Furnace-Basic Oxygen Furnace (BF-BOF) routes.

According to EY estimates, utilising 14kg of green hydrogen per ton of steel in the BF-BOF process could reduce CO_2 emissions by approximately 8% to 2.14 tons of CO_2 per ton of steel. And, adding 65kg of green hydrogen per ton of steel into the DRI-EAF process, which is natural gas-based, could reduce CO_2 emissions by 53% to 0.65 tons of CO_2 per ton of steel. These estimates consider only the use of green hydrogen in the DRI shaft and not the use of renewable energy in the EAF.

While the potential reduction of CO_2 emissions is evident, the costs of green steel need to be further assessed under various scenarios of green hydrogen applications in the steelmaking process. One of the estimates available indicates that green steel will cost INR55,000–65,000 per ton (USD622–735), roughly 20-30% higher than conventional steel.

Given the cost differential, domestic use of green steel in the private sector will be challenging. However, the government could mandate a certain percentage of green steel use in large public sector infrastructure projects, in which the costs are amortised over several years. Green building codes for private sector buildings could facilitate the adoption of green steel. According to Bain et al.'s estimates, mandating a 10–15% share of green steel in public procurement could generate 0.4–0.6 MMTPA of green hydrogen demand by 2030 **(Table 3)**.

However, green steel prices should be more suitable for exports to Europe in the near term, given the upcoming CBAM regulations. Elsewhere, in Vietnam and the Middle East, the export situation does not look bright with increasing competition from Chinese steel manufacturers.

Chemicals, glass, and ceramics

The chemicals, glass, and ceramics sectors utilise hydrogen extensively, both as a fuel and as a process gas, in their production processes. These sectors are challenging to electrify and, therefore, difficult to decarbonise. Replacing grey hydrogen in these sectors with green hydrogen will allow the decarbonisation of these sectors.

To create immediate demand for green hydrogen in these sectors, a 10–20% blending with grey hydrogen may be encouraged, driving demand in the range of 0.04–0.07MMTPA by 2030 **(Table 3)**. A 20% blending of green hydrogen can reduce CO_2 emissions by 6–7%, according to a study conducted by NTPC for the Firozabad glass cluster. SBI Caps estimates that the adoption of green methanol (a derivative of green hydrogen) in the chemicals sector will increase to 1.95–2.60MMTPA by 2030.

However, one of the challenges to the adoption of green hydrogen in these sectors is that many of the players are small and medium-sized enterprises. These enterprises may not make bulk purchases of hydrogen and often tend to purchase hydrogen at higher prices than the bigger players. While these players could be the ideal candidates to transition to green hydrogen (given their procurement prices), achieving scale economics would require demand aggregation at a regional or cluster level. Furthermore, the government may need to facilitate the development of common infrastructure for the transportation and storage of green hydrogen in these industrial clusters.

Transportation

Decarbonisation of transportation is being predominantly led by electrification and flex-fuel vehicles, which use a mix of fossil fuels and biofuels, or CNG. While electric vehicles and CNG vehicles are primarily driving the transition in two-wheelers, three-wheelers, and cars, green hydrogen may find applications in long-haul, heavy-duty trucking, shipping, and aviation.

Hydrogen fuel cell trucks offer certain advantages over battery electric trucks, including a longer range and quicker refuelling. However, battery electric vehicle technology is rapidly evolving and improving. Furthermore, hydrogen fuel cell trucks are less energy-efficient than battery electric trucks and require additional infrastructure for transporting and storing hydrogen.

Despite the challenges, hydrogen may find niche applications, such as long-distance trucking and shipping in the transportation sector, accounting for about 1.35–1.80MMTPA by 2030 **(Table 3)**. Green hydrogen may also see applications in the aviation sector, either through direct application via hydrogen fuel cells or as a feedstock for electro-sustainable aviation fuels (e-SAF). The government is working towards introducing a SAF policy for the aviation sector with a blending target of 5% by 2030. India's vision for SAF may include fuels drawn from biomass (e.g., ethanol) as well as synthetic SAF, which is created by combining green hydrogen with CO_2 captured from the atmosphere. While standards for SAF are yet to be announced, 2% e-SAF use in aviation turbine fuel by 2030 could drive a 0.74MMTPA demand in green hydrogen demand, according to EY estimates **(Table 3)**. Pilots initiated by the government, along with policy support for green hydrogen initiatives, will likely drive the adoption of green hydrogen in the transportation sector.

Exports

The Indian government expects a global demand of over 100MMTPA by 2030 for green hydrogen and its derivatives, such as green ammonia. According to government estimates, India could potentially address 10% of the global export market, translating to 10 MMTPA per year of green hydrogen/ammonia demand.

Japan and South Korea, along with several EU nations, are likely to rely on imports of green hydrogen and ammonia due to land constraints and a lack of renewable energy resources for local production. Some of these countries even offer long-term purchase contracts and incentives for importing green hydrogen. Bain et al.'s estimates indicate that if India captures 5–7.5% of the green hydrogen import demand of these countries, India could see a demand of about 0.75–1.1MMTPA of green hydrogen by 2030 **(Table 3)**.

Given India's push to economically produce green hydrogen/ammonia, coupled with one of the lowest costs of renewable power generation in the world, India is well placed to capture a significant portion of the export market.

However, to tap into green hydrogen/ammonia export markets, India must build the necessary port infrastructure. In addition, the varying definitions of green hydrogen create uncertainty until a globally accepted emissions accounting framework for green hydrogen and its derivatives is developed.

Way forward

Green hydrogen is a versatile fuel and feedstock with potential to decarbonise several sectors, particularly those that are hard to abate, such as refining, fertilisers, chemicals, and steel. Additionally, it can facilitate cross-border sustainable fuel trade through the exchange of green hydrogen or its derivatives, such as green ammonia.

While policy nudges and high-level decarbonisation goals will likely drive the demand for green hydrogen to some extent, sustained demand generation in the long term will require global collaboration and concrete steps toward the domestic adoption of green hydrogen. We highlight a few steps below:

A globally accepted emissions accounting framework for hydrogen

Green hydrogen and its derivatives, such as green ammonia and e-methanol, are expected to become globally traded commodities that will aid in decarbonising hard-to-abate sectors in high-energy-demand countries. However, differing definitions and emission standards of green hydrogen across countries and regions are becoming a barrier to the development of hydrogen trade.

Even within countries/regions, market fragmentation can occur, with some projects and related infrastructure developed for the domestic market, while others are designed to address export markets. This lack of a common framework will lead to inefficiencies in the use of shared infrastructure and also create regulatory hurdles due to difficulties in implementing certification schemes. These uncertainties are increasing investment risks and slowing down the commissioning of projects in some countries/regions.

While implementing a common standard for green hydrogen globally will be challenging, countries/regions can collaborate on a unified framework for emissions accounting of green or low-emissions hydrogen. The International Energy Agency recommends that countries adopt a hydrogen product passport (with a unique ID) that contains the emissions intensity rating as well as other environmental measures for a cargo of hydrogen. This unique ID can be linked to a data repository that will be accessible to trading partners and end-users.

Establishing a uniform methodology for defining hydrogen by its emissions intensity is essential to enable compatibility across regulatory frameworks and certification systems. India should collaborate with countries involved in hydrogen trading to develop a universally accepted framework for accounting for emissions. This will facilitate interoperability and minimise market fragmentation, unlocking investment and accelerating deployment.

> **“Driving sustained demand for green hydrogen will require bold, sector-specific domestic initiatives coupled with strategic international partnerships to unlock export potential.**

Hydrogen purchase obligations

HPOs, a demand-side intervention, could drive demand for green hydrogen by mandating industries to procure a defined percentage of their total energy consumption from green hydrogen. Such interventions are not new to India and have been implemented in other sectors, such as the power sector, in the form of renewable purchase obligations and energy storage obligations.

Progressive HPOs requiring the purchase of green hydrogen can be initially imposed on existing grey hydrogen users and later extended to cover other hard-to-abate sectors. HPOs for specific sectors could be paired with national demand aggregation mechanisms, and auctions could be facilitated through a national implementing agency to ensure scale and price discovery. Such a mechanism can create certainty and sustained demand, and has the potential to incentivise investments in green hydrogen production and allied infrastructure.

However, implementing HPOs in several sectors requires inter-ministerial agreement and coordination. India's upcoming CCTS may also support the implementation of HPO as the scheme imposes sectoral emissions reduction targets. Nevertheless, specific targets for green hydrogen use in various industrial sectors will help create sustained demand for it.

Hydrogen hubs

The lack of adequate support infrastructure—additional renewable energy capacity, power evacuation lines, hydrogen storage tanks and pipelines, domestic electrolyser manufacturing capacity—threatens to delay the commissioning of green hydrogen projects. Any steps that accelerate the development of this infrastructure would help lower the on-the-ground project execution risks of green hydrogen projects.

Developing geographically concentrated ecosystems for green hydrogen can help scale up its use, reduce costs, and accelerate infrastructure development. By co-locating hydrogen production, transportation, storage, and consumption points, economies of scale could be created, lowering the cost of delivered green hydrogen. Sharing infrastructure will also ensure the efficient utilisation of expensive infrastructure build-outs.

Globally, hydrogen hubs are gaining prominence, with the Port of Rotterdam in the Netherlands setting an example. India had also planned to set up at least two green hydrogen hubs with an outlay of INR4 billion (USD45.4 million) by 2025–26 under the NGHM. Each hub was to have green hydrogen production capacity of at least 100,000MTPA. However, the tender issued in August 2024 was cancelled in July 2025 due to unspecified reasons.

Regardless of the technical challenges of producing green hydrogen at scale—upwards of 100,000MTPA in a single location—and the significant upfront investment required to set up all the components of a hub, establishing these hubs must be pursued, given the numerous advantages they bring to setting up the hydrogen ecosystem.

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About the Authors

Charith Konda

Charith is an Energy Specialist, India Mobility and New Energy at IEEFA. He works on issues related to clean mobility, newer clean energy technologies, and the overall energy transition challenges of the economy. Charith has around two decades of professional work experience in public policy advisory, consulting, and business & policy research in a wide range of global firms. His interest lies at the intersection of government and private enterprise in the sectors of energy & environment, mobility, infrastructure, and technology. ckonda@ieefa.org

Kaira Rakheja

Kaira Rakheja is an Energy Analyst at IEEFA, where she is engaging in tracking and analysing India's progress towards its energy transition goals. Her role includes assessing the critical mineral supply chain within the country and analyzing the growth in renewable energy capacity and investments. Kaira is committed to understanding and prioritizing the resilience and the self-sufficiency of energy transition mechanisms within and outside the country. krakheja@ieefa.org

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