

India Hydrogen Market By Technology (Steam Methane Reforming, Membrane Cell Technology, Methanol Reforming, Coal Gasification and others), By Mode (Captive, Merchant), By Application (Petroleum Refinery, Fertilizers, Chemical & Petrochemical, Metal Processing, Automotive, Energy and Others), By Region, Competition, Forecast and Opportunities, 2020-2030F

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Report description:

India Hydrogen Market achieved a total market volume of 7.12 Million Tonnes in 2024 and is expected to reach 10.78 Million Tonnes by 2030 with a CAGR of 7.35% during the forecast period. In its molecular state (H₂), hydrogen is a colorless, odorless gas with high flammability. It can generate electricity through fuel cells, with water as the sole byproduct, and is a promising clean energy option for vehicles and power generation. Hydrogen is also essential in producing ammonia for fertilizers, refining petroleum, and various chemical processes, and is a critical component in rocket fuel.

India is aiming for net-zero carbon emissions by 2070, with hydrogen playing a key role in achieving this goal, especially in transportation, industrial processes, and energy storage. To support this, the Indian government has implemented several policies to advance hydrogen adoption. The National Green Hydrogen Mission, launched in early 2023, seeks to position India as a global leader in green hydrogen, with ambitious targets for production, infrastructure, and R&D.

There is increasing investment from both domestic and international sources, and technological advancements in electrolyzers and fuel cells are lowering hydrogen production costs, enhancing its competitiveness with traditional energy sources. Despite these advancements, green hydrogen production remains expensive compared to fossil fuels, and ongoing efforts focus on reducing costs through innovation and scale. Establishing the necessary infrastructure for hydrogen production, storage, and distribution is capital-intensive and requires considerable coordination. Evolving regulations and policies may introduce

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uncertainty for investors and stakeholders in the hydrogen sector.

The Indian hydrogen market is undergoing significant growth as the country embraces sustainable energy solutions to tackle climate change and enhance energy security, with hydrogen poised to be a crucial element in India's energy transition strategy.

Key Market Drivers

Net-Zero Emission Targets

At the 26th session of the United Nations Framework Convention on Climate Change (COP 26) in November 2021, India set a target to achieve net-zero carbon emissions by 2070. This commitment has established a robust regulatory framework that encourages the adoption of clean energy technologies, including hydrogen. It has led to the development of supportive policies and incentives to boost hydrogen production and use. According to the NITI Aayog and RMI report, *Harnessing Green Hydrogen: Opportunities for Deep Decarbonisation in India*, domestic hydrogen demand in India is expected to reach 11 million tons by 2030. With the National Green Hydrogen Mission (NGHM) in place, green hydrogen's share in this demand could rise to 46 percent by 2030, compared to 16 percent without such policy measures.

In April 2024, the Ministry of New and Renewable Energy (MNRE) issued guidelines for the SIGHT Programme, Component II, which provides incentives for green ammonia production under Mode 2A, targeting the fertilizer sector. The pursuit of net-zero goals is attracting significant investment from both public and private sectors into hydrogen technologies. These policies are creating a favorable market environment by setting clear targets for hydrogen production, infrastructure, and usage.

Investors are increasingly interested in the hydrogen sector due to its role in meeting emission reduction targets, which is leading to funding for research, infrastructure, and innovation. For example, in 2024, Oil India Limited (OIL) signed a Memorandum of Understanding (MoU) with The Fertilisers and Chemicals Travancore Limited (FACT) to explore green hydrogen opportunities, including green ammonia, green methanol, and other derivatives, and to collaborate on decarbonization initiatives like carbon dioxide sequestration.

The push towards net-zero emissions is accelerating advancements in hydrogen technologies, motivating companies and research institutions to innovate electrolyzers, fuel cells, and storage solutions. The need to reduce carbon emissions across various sectors such as transportation, industry, and power generation increases demand for hydrogen as a clean energy carrier. India's net-zero emission targets are driving significant growth in the hydrogen market, fostering innovation, investment, and infrastructure development for a sustainable energy future.

Technological Advancements

Advancements in electrolysis technology, such as enhanced electrolyzers, have significantly reduced hydrogen production costs. More efficient and cost-effective electrolysis methods are enabling cheaper production of green hydrogen, making it increasingly competitive with traditional energy sources. In 2023, Hild Electric was selected as the Alkaline electrolyzer technology provider for NTPC Renewable Energy. This collaboration involved deploying electrolyzer stacks, along with purifiers and separators, to create a system capable of integrating with renewable energy sources to produce green hydrogen.

Improvements in fuel cell technology are also enhancing the efficiency of hydrogen as an energy carrier. Better-performing fuel cells result in higher energy conversion rates, making hydrogen a more practical option for various applications, including transportation and stationary power generation. In 2023, Tata Motors launched two advanced R&D facilities aimed at supporting its goal of providing sustainable mobility solutions. These facilities include an engine test cell for developing hydrogen internal combustion engines and the infrastructure needed for the storage and dispensing of hydrogen fuel for fuel cell and H2ICE vehicles.

Technological advancements in hydrogen infrastructure, such as refueling stations and pipelines, are facilitating the expansion of the hydrogen market. Enhanced infrastructure supports the distribution and use of hydrogen, increasing its accessibility and adoption. In 2024, India inaugurated its first Multi-Purpose Green Hydrogen Pilot Project in Himachal Pradesh, further advancing the market. Emerging technologies are broadening the applications of hydrogen, from fuel cells in vehicles to industrial processes and power generation. Innovations in these areas are driving demand and creating new market opportunities. In March 2024, India began developing its own pure-hydrogen-based direct reduction of iron (DRI) technology for green steel production. This technology is still in development, with ministries such as Steel and MNRE, along with industry players, working together to

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advance pilot projects. Technological advancements in hydrogen production, storage, and applications are crucial for the growth of the hydrogen market in India. These innovations reduce costs, enhance efficiency, and expand hydrogen's range of uses, fostering a more favorable environment for market development and adoption.

Key Market Challenges

High Production Costs

Hydrogen production via electrolysis is more costly compared to traditional methods like steam methane reforming (SMR) and other energy sources. This higher cost makes green hydrogen less competitive in the energy market. As production costs rise, so do hydrogen prices, which can dissuade potential users and hinder market adoption. The substantial capital required for hydrogen production technologies, coupled with high costs, increases financial risk for investors. This risk can limit investment availability and slow the advancement of hydrogen technologies. Achieving economies of scale is essential for reducing hydrogen production costs, but scaling up production facilities demands significant investment and infrastructure development, which can be challenging in the early stages. Although new technologies offer potential, scaling them to a point where they can substantially reduce production costs remains difficult. As a result, hydrogen can struggle to compete with other energy sources and technologies that have lower production costs, such as natural gas and renewable energy, which can impede market growth. Hydrogen, being the smallest and lightest molecule, necessitates high-pressure storage systems to be economically viable. Developing and maintaining these systems is costly and technically complex, which can hinder widespread adoption. Advanced materials are required for storage containers to prevent leaks and ensure safety, adding further expense and technical challenges. The infrastructure needed for hydrogen transportation, including pipelines and distribution networks, demands significant investment. Existing infrastructure often isn't compatible with hydrogen, requiring new construction or major upgrades. Transporting hydrogen, whether in compressed, liquid, or chemical forms, is also expensive. The costs associated with developing and maintaining these transportation systems impact the overall economics of hydrogen as a fuel. Hydrogen's high flammability necessitates strict safety measures during transportation, increasing both complexity and costs. Integrating hydrogen storage and transportation with existing energy infrastructure involves technical and logistical challenges. This often requires modifications or entirely new systems, further complicating and raising the costs of deployment.

Lack of Skilled Workforce

The hydrogen sector demands specialized skills and expertise in areas such as electrolysis, fuel cell technology, and hydrogen infrastructure. The current shortage of professionals with these specific skills impedes the development and implementation of hydrogen technologies. There is a pressing need for comprehensive training and development programs to build a skilled workforce. Developing these programs requires both time and investment; without them, the industry may struggle to attract qualified personnel. The complexity of hydrogen technologies necessitates a thorough understanding of advanced engineering principles and safety protocols, and a lack of skilled experts to handle these technical aspects can slow down project progress and innovation.

As the hydrogen sector evolves rapidly, staying updated with technological advancements requires continuous learning and adaptation. The shortage of skilled workers limits the ability to address these evolving knowledge gaps and advance the industry. As the hydrogen market expands, the demand for skilled professionals will increase. Without a steady supply of qualified individuals, the industry may face bottlenecks that could hinder its growth and the effective scaling of hydrogen technologies.

Key Market Trends

Growing Adoption of Hydrogen Fuel Cell Vehicles

Several leading automotive manufacturers have launched hydrogen fuel cell vehicles (FCVs) in the Indian market, with both global and local brands contributing to growing consumer interest and market expansion. In 2023, Tata Motors received a CMVR Type Approval certificate for India's first green hydrogen fuel cell electric bus, the Tata Starbus 4/12 FCEV, and its variants. Both companies and government agencies are increasing their use of hydrogen FCVs, including deploying these vehicles in public transportation and industrial settings. The Indian government is actively promoting the adoption of hydrogen FCVs through financial incentives, subsidies, and grants, aimed at lowering the costs associated with purchasing and operating these vehicles. Additionally, the government has introduced a Rs. 496 crore scheme (until 2025-26) to support pilot projects that test the feasibility of green hydrogen as a fuel for cars and heavy vehicles.

Technological advancements are improving the efficiency, performance, and reliability of hydrogen FCVs, making them more

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competitive with traditional and other alternative fuel vehicles. For example, in July 2024, Triton Electric Vehicle LLC announced a new hydrogen internal combustion engine, which uses hydrogen as a clean, cost-effective fuel, producing only water vapor and no pollutants. India is also engaging in international partnerships to exchange knowledge, technology, and best practices in hydrogen FCVs. In January 2024, Hyundai Motor Company revealed plans to invest USD 746 million to develop a hydrogen automotive ecosystem in India. The increasing adoption of hydrogen fuel cell vehicles in India is a clear indication of the shift towards more sustainable transportation solutions. With supportive government policies, ongoing technological advancements, and expanding infrastructure, hydrogen FCVs are set to play a pivotal role in India's move towards a sustainable energy future.

Segmental Insights

Technology Insights

Based on Technology, the Steam Methane Reforming emerged as the dominating segment in the Indian market for Hydrogen in 2024. This is driven by its cost-effectiveness, proven technology, established infrastructure, and the availability of natural gas. SMR stands out as the most economically viable option for large-scale hydrogen production. It utilizes natural gas, which is relatively low-cost and readily available compared to other feedstocks. India's extensive infrastructure for natural gas extraction, transport, and processing further supports SMR as a cost-efficient choice. The existing hydrogen production facilities in India predominantly use SMR, establishing a strong industry precedent. Additionally, SMR's capability to produce hydrogen at scale is crucial for fulfilling the needs of various sectors, such as refineries and fertilizer plants, where hydrogen is a key feedstock.

Application Insights

Based on Application, Petroleum Refining emerged as the dominating segment in the Indian market for Hydrogen in 2024. Hydrogen plays a vital role in the hydrocracking and desulfurization processes within petroleum refining. It is essential for removing sulfur from crude oil, thereby producing cleaner fuels, which is a key aspect of refining operations in India. The application of hydrogen in refining is a well-established practice, with technologies like hydrocracking and hydrodesulfurization being mature and widely implemented. In 2023, Indian Oil Corporation (IOC) announced plans to install green hydrogen plants at all its refineries by 2047, as part of INR 2 lakh crore green transition initiative aimed at achieving net-zero emissions. A significant portion of the hydrogen produced in India is utilized by petroleum refineries, making this sector the largest hydrogen consumer. The infrastructure and technology for hydrogen use in refining are well-developed. Refineries are a critical component of India's energy sector, and their extensive hydrogen usage solidifies its position as the leading application in the hydrogen market. There is a strategic emphasis on enhancing and expanding refining capabilities, which includes increasing hydrogen use to improve processing efficiency and meet regulatory standards. Additionally, in July 2024, Bharat Petroleum Corporation Limited (BPCL) announced plans to build a new 12 million metric tonnes per annum (MMTPA) refinery, reflecting ongoing significant investments in refining technology to boost efficiency and comply with environmental standards. This continuous investment ensures a sustained high demand for hydrogen.

Regional Insights

Based on Region, West India emerged as the dominant region in the Indian market for Hydrogen in 2024. Western India, notably Gujarat and Maharashtra, is home to some of the country's largest and most advanced oil refineries, including those operated by Reliance Industries and Indian Oil Corporation. These refineries are significant hydrogen consumers due to their reliance on hydrogen for hydrocracking and desulfurization processes, which are crucial for producing cleaner fuels. Additionally, the region houses substantial petrochemical complexes that use hydrogen in various industrial applications. The Western region benefits from a comprehensive industrial infrastructure, including facilities for hydrogen production, storage, and transportation. Its economic policies have supported growth across multiple sectors, such as chemicals, petrochemicals, and metal processing, all of which heavily depend on hydrogen, reinforcing the region's market leadership.

Western India also has access to major ports like Kandla, which facilitate the import of raw materials and the export of hydrogen and hydrogen-based products. In 2024, Maharashtra's state government signed seven memoranda of understanding (MoUs) for green hydrogen projects valued at INR 2,76,300 crore and an MoU with ArcelorMittal Nippon Steel for a INR 40,000 crore steel plant. These initiatives aim to produce 910 KTPA of green energy and create 63,900 jobs. The Gujarat state government has actively promoted industrial development and infrastructure enhancements, including policies that incentivize investments in hydrogen technology and renewable energy, further driving the adoption and integration of hydrogen in industrial processes.

Key Market Players

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- ?□Reliance Industries Limited
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- ?□Indian Oil Corporation Limited
- ?□INOX-Air Products Inc.
- ?□DCW Limited
- ?□Larsen & Toubro Limited
- ?□Grasim Industries Limited.
- ?□Bhuruka Gases Limited
- ?□Air Liquide India
- ?□Tata Chemicals Limited

Report Scope:

In this report, the India Hydrogen Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

?□India Hydrogen Market, By Technology:

- o Steam Methane Reforming
- o Membrane Cell Technology
- o Methanol Reforming
- o Coal Gasification
- o Others

?□India Hydrogen Market, By Mode:

- o Captive
- o Merchant

? India Hydrogen Market, By Application:

- o Petroleum Refinery
- o Fertilizers
- o Chemical & Petrochemical
- o Metal Processing
- o Automotive
- o Energy
- o Others

?□India Hydrogen Market, By Region:

- o West India
- o North India
- o South India
- o East India

Competitive Landscape

Company Profiles: Detailed analysis of the major companies presents in the India Hydrogen Market.

Available Customizations:

India Hydrogen Market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

?□Detailed analysis and profiling of additional market players (up to five).

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