

Global Hydrogen Market: Analysis By Demand, By Production, By Sector, By Source, By Technology, By Region Size and Trends with Impact of COVID-19 and Forecast up to 2028

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Abstracts

Hydrogen is a gas with no color and odour and has the lowest density of all gases. Hydrogen is viewed as a crucial way of decarbonizing the global economy, reducing greenhouse gas emissions and limiting the effects of global warming. The hydrogen market is primarily focused on refining crude oil, producing ammonia fertilizers and processing metals. However, in recent years, an ongoing effort has been made to make it a viable renewable energy source as the advantage of employing hydrogen as an energy carrier is that the only byproducts are water and heat when it reacts with oxygen. Although hydrogen is currently a relatively small market, pollutive, and dedicated to specific industries (refineries, chemical production), it has become the source of a lot of hope for the energy transition, as it represents a key solution for the storage of energy and does not emit CO₂ when it is "green". Global hydrogen market demonstrated a consistent growth, primarily driven by increasing demand for hydrogen-based fuels, growing focus on industrial decarbonization and desulfurization to meet sustainability goals, and ongoing developments in steel and power generation industries to meet with the growing global electricity demand. The global hydrogen market value stood at US\$156.76 billion in 2022, and is expected to grow at a CAGR of 6.37% over the projected period of 2023-2028.

The global hydrogen market demand has been rapidly growing in recent years due to hydrogen's potential to act as a sustainable alternative to fossil fuels, particularly in the power generation and transportation sectors. The increasing proliferation of applications is a major driver behind the growing demand, although industrial demand itself (virtually the only major consumer today) will also rise. Commitments by major economies to

achieve net-zero emissions by 2050, declining costs of renewable energy sources, like solar and wind, and emerging applications of hydrogen in sectors like steel manufacturing, which traditionally relied heavily on coal, present new avenues for hydrogen consumption. The global hydrogen market demand is projected to increase to 138.48 million metric tons by 2030.

Global commitment to reduce carbon footprints leading to investments in cleaner production methods like electrolysis, a surging interest in 'green hydrogen' harnessed from renewable energy, and the unmatched flexibility of hydrogen in energy storage and release, vital for grid stabilization amid the influx of variable renewable energy, have been some of the pivotal reasons associated with increased hydrogen production in the market. The global hydrogen market production is anticipated to be 682.50 million metric tons in 2050.

Market Segmentation Analysis:

By Technology: The report provides the bifurcation of the hydrogen market value into four segments based on technology: steam methane reforming, electrolysis, coal gasification, and others. Steam methane reforming is the largest segment of global hydrogen market owing to increasing crude oil consumption, favorable government policies and efforts towards the refurbishment of existing refining facilities, increased global demand for hydrogen as a clean energy carrier, ongoing research and development efforts aimed at improving the efficiency & environmental performance of SMR technology, and the presence of well-maintained supply chain and existing infrastructure for methane extraction, transportation, and distribution. Electrolysis is the fastest growing segment of hydrogen market owing to increased need for renewable energy sources for the fulfillment of ambitious decarbonization targets and net-zero emissions goals, favorable government policies and incentives to promote the use of hydrogen & green hydrogen production, and falling prices of electrolyzer equipment.

By Sector: The report provides the bifurcation of the hydrogen market demand into five segments on the basis of sector: existing industry use, mobility, power generation, building and industry heat, and new industry feedstock. The hydrogen demand for mobility will continue to grow at a fast pace in the forecasted period, owing to, increasing investment in fuel cells, continuous deployment of fuel cell vehicles and setup up of new hydrogen refueling stations to provide customers with readily available fuel, growing focus to increase the decarbonization of transportation sector, and increasing sale of fuel cell electric vehicles (FCEV) by major companies in the sector.

By Source: The report provides the bifurcation of the hydrogen market production into three segments on the basis of source: grey, renewable and low carbon. Today's hydrogen is mostly grey hydrogen (i.e., produced from fossil fuels). There is hardly any production capacity for green hydrogen as of today. Green hydrogen would represent two-thirds of the total hydrogen output of by 2050 while low carbon would account for the remainder by then. Renewable hydrogen production will rapidly increase in the upcoming years due to global transfer towards sustainable energy and net zero carbon emissions, increased need to decarbonize existing power systems, and long-term viability and sustainability associated with the production method. Similarly, increased focus of industries on carbon footprint reduction, and low cost associated with low carbon hydrogen production in comparison to other hydrogen production, indicate increased low carbon hydrogen production in the forecasted years. Also, according to IEA, in January 2022, there were at least 50 blue hydrogen projects in the works around the world, with capacity expected to grow more than tenfold by 2030, further implying high low carbon hydrogen production.

By Region: The report provides insight into hydrogen market value based on the regions namely, Europe, North America, Asia Pacific, and rest of the world. Asia Pacific hydrogen market is the largest and the fastest growing region of global hydrogen market, owing to rising demand for clean energy, strong presence of refineries in major countries such as China and India, favorable government policies, rising hydrogen demand for power generation, growing investments in hydrogen refueling infrastructure, and increasing adoption of transportation solutions such as electric vehicles and automated buses in many Asian economies.

China is the world's largest consumer of H₂ produced from fossil fuels, owing to rising investments in clean energy-based power plants, major research and development activities in the region targeting to reduce the cost of green hydrogen generation, and strong government support. According to the National Development and Reform Commission (NDRC) and energy regulator National Energy Administration (NEA), by 2025, China plans to manufacture 100,000-200,000 metric tons of green hydrogen from renewable sources per year, reducing CO₂ emissions by 1-2 million metric tons annually.

North America hydrogen market has been positively expanding over the years, as a result of, country's high energy demands, ongoing adoption of advanced hydrogen-based technologies, growing demand of hydrogen for petroleum refining and ammonia manufacturing, and presence of comprehensive gas pipelines in North American countries. The US is the largest region within North America. The US Infrastructure and

Jobs Act has budgeted US\$9.5 billion for research, development and demonstration for hydrogen related projects until 2026, of which US\$8 billion will be set aside for project development. The US hydrogen market is also further divided into three segments on the basis of technology namely, steam methane reforming, coal gasification, and others, where the US steam methane reforming hydrogen market is the largest segment.

Market Dynamics:

Growth Drivers: The global hydrogen market has been rapidly growing over the past few years, due to factors such as increasing usage of ammonia-based fertilizers, rising demand of hydrogen by various end user industries, favorable government policies and initiatives, rising demand to decarbonize energy end-use, increasing use of hydrogen as rocket propellants, etc. Mushrooming demand for hydrogen in refining industry for cracking long-chain hydrocarbons into shorter chains, and removing sulfur compounds from crude oil during the production of gasoline have been positively contributing to the increased demand for hydrogen. Also, increased emphasis on fuel gas desulphurization, significant interest in achieving carbon neutrality by government of major economies, and various government authorities and agencies introducing favorable initiatives, investments, funds, and incentives to spur hydrogen production and meet ambitious climate-neutral targets, will continue to boost the growth of global hydrogen market in the forecasted period of 2023-2028.

Challenges: However, the market growth would be negatively impacted by various challenges such as high energy conversion losses, increased competition from alternative technologies, etc. Hydrogen must be stored in gaseous form to be used as a fuel cell, and this method of hydrogen storage leads to inherent loss of energy as compressing hydrogen utilizes 13% of total energy content by itself and if it is liquified, then it loses about 40% of energy.

Trends: The market is projected to grow at a fast pace during the forecasted period, due to, rising adoption of hydrogen fuel cells, increasing number of hydrogen projects, falling distribution cost of hydrogen, growing use of green hydrogen, rising focus on achieving net zero emissions target, ongoing technological advancements in hydrogen generation, etc. Major corporations and organizations are undertaking an increasing number of hydrogen projects to boost the overall production and consumption of hydrogen, while creating new business opportunities and investment prospects in the hydrogen market in the forecasted period. In addition, there has been an increase in the number of initiatives by both developed and developing countries to generate green hydrogen in order to meet the rising global demand for green hydrogen. Thus, augmenting the

growth of global hydrogen market in the years to come.

Impact Analysis of COVID-19 and Way Forward:

COVID-19 brought in many changes in the world in terms of reduced productivity, loss of life, business closures, closing down of factories and organizations, and shift to an online mode of work. The COVID-19 pandemic had a detrimental impact on the hydrogen market. The initial shockwave of the pandemic disrupted supply chains and slowed down industrial activities, causing a drop in hydrogen demand across various sectors. Lockdowns and economic uncertainties prompted curbs on investment, causing a slowdown in the expansion of clean energy initiatives, including hydrogen-related projects. Lockdowns and economic uncertainties led to project delays and cancellations, especially in industries heavily reliant on hydrogen, such as automotive and manufacturing. As governments redirected resources towards pandemic relief efforts, funding for hydrogen research and infrastructure projects often took a backseat, resulting in a slowdown of hydrogen-related initiatives. This lack of financial support hindered the development and scaling up of hydrogen technologies.

Competitive Landscape:

The global hydrogen market is mildly consolidated with the top players of the market acquiring majority of the market share, and increasing number of regional and local players worldwide catering to the local demand and engaging in various research & development activities and initiatives, collaborations and products launches to develop and deploy new and more efficient products in the market. For instance, On April 20, 2023, Linde plc announced that the company has signed a long-term agreement to supply green hydrogen to Evonik, a specialty chemicals company, where Linde will build, own and operate a nine-megawatt alkaline electrolyzer plant on Jurong Island, Singapore, to produce green hydrogen. Similarly, on May 26, 2022, ACWA power, OQ and Air Products signed joint development agreement toward world-scale green hydrogen-based ammonia production facility in Oman.

The key players of the hydrogen market are:

BP plc.

Air Products and Chemicals, Inc.

Nel ASA

Linde plc

FuelCell Energy, Inc.

Iwatani Corporation

Messer SE & Co. KGaA

Air Liquide S.A.

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