KPMG

India's green hydrogen ambition

Setting the wheels in motion

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01 Green hydrogen: Capturing the imagination of world

Green hydrogen and its derivatives are expected to play a critical role in the world for decarbonisation at scale owing to its versatility enabling its use in many applications. Green hydrogen will also aid the decarbonisation of hard to abate sectors.

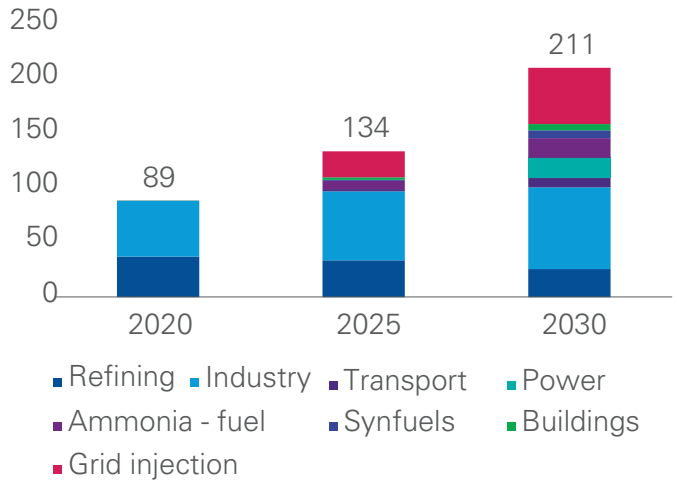
The resource is also a 'drop in' for many applications as the world already consumes nearly 90 Million Tonnes Per Annum (MTPA) of hydrogen.[1]

Currently, more than 95 percent[2] of the world's hydrogen is fossil fuel based, produced via Steam Methane Reforming (SMR) or coal gasification. Production of hydrogen emits 9-10 kg CO_2/kg of hydrogen via SMR process[3], and emits 4.1-5.2 kg CO_2/kg via subbituminous coal gasification process.[4] Through renewable energy-powered electrolysis, net emissions would be minimal in contrast, considering the usage of carbon-free sources of electricity and feedstock fuel in this production value chain.

The demand for hydrogen is expected to be more than 200 MTPA in 2030. By 2050, around one-third of hydrogen demand in IEA's Net-zero Emissions Scenario[5] is expected to be used for hydrogen-based fuels such as ammonia, synthetic kerosene and synthetic methane. Ammonia use could expand

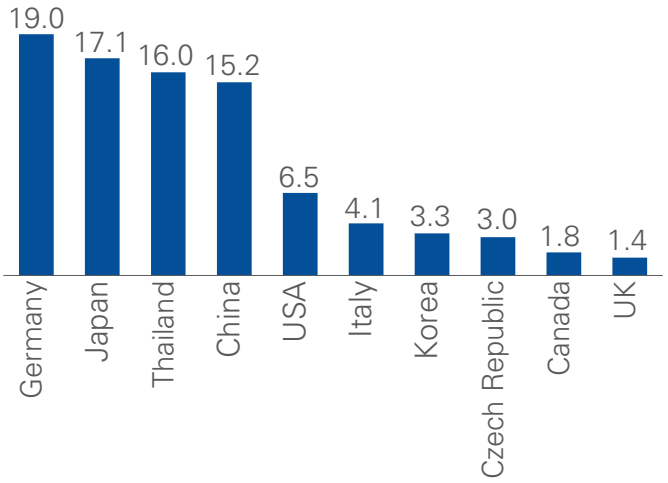
1. IEA, 2021
2. Forbes, June 2020
3. Argonne GREET Publication: Updates of Hydrogen Production from SMR Process in GREET® 2019 (anl.gov)
4. Carbon footprint of the hydrogen production process utilizing subbituminous coal and lignite gasification - ScienceDirect
5. IEA, 2021

Global hydrogen demand by sector (Mt H_2/year)



Source: IEA, 2020

Global hydrogen electrolyser market share (2020)



Source: Clean Energy Wire 2020

beyond existing applications (viz primarily nitrogen fertilisers) and could be adopted for use as a fuel. Overall, hydrogen and hydrogen-based fuels are expected to meet 10 percent of global final energy demand in 2050.[5]

This offers a great prospect for low-carbon hydrogen because of its ability to support decarbonisation of many sectors. Many countries have taken the first step towards a low-carbon hydrogen-based economy by establishing strategies, policies, initiatives, and pilot projects. Among low-carbon hydrogen production methods, Green hydrogen is expected to take the center stage at the next round of global decarbonization initiatives.

In 2021 United Nations Climate Change Conference (COP26) in Glasgow, 32 countries and the European Union (EU) agreed to work together to accelerate the development and deployment of clean hydrogen and ensure that 'affordable renewable and low-carbon hydrogen is globally available by 2030'.[6]

As of end-2021,12 countries and the European Union (EU) have published their national low-carbon hydrogen strategies.[7] Several other countries have published or are currently drafting their low-carbon hydrogen strategies, demonstrating a clear acceleration of government interest backed by, potentially, COP26 acting as a catalyst.

Globally, many countries have also made substantial progress towards aligning their strategies as a demand center or a supply leader. Countries such as **Germany**, **Japan**, and **South Korea** are predicted to be net importers of hydrogen, while **Chile** and **Australia** may play a huge role in hydrogen export.

Few countries have been particularly influential with their hydrogen strategies.

Japan's early commitment catalyzed interest in the Asia-Pacific region, with South Korea and Australia publishing their own strategies shortly afterwards. **Japan** is pursuing hydrogen (particularly green hydrogen) production facilities projects overseas for large-scale hydrogen imports, with partnerships with Australia and Brunei, as it aims to import 300,000 tons of the fuel a year by around 2030.

6. UNFCCC, 2021
7. National Hydrogen Strategies published until 07/06/2021

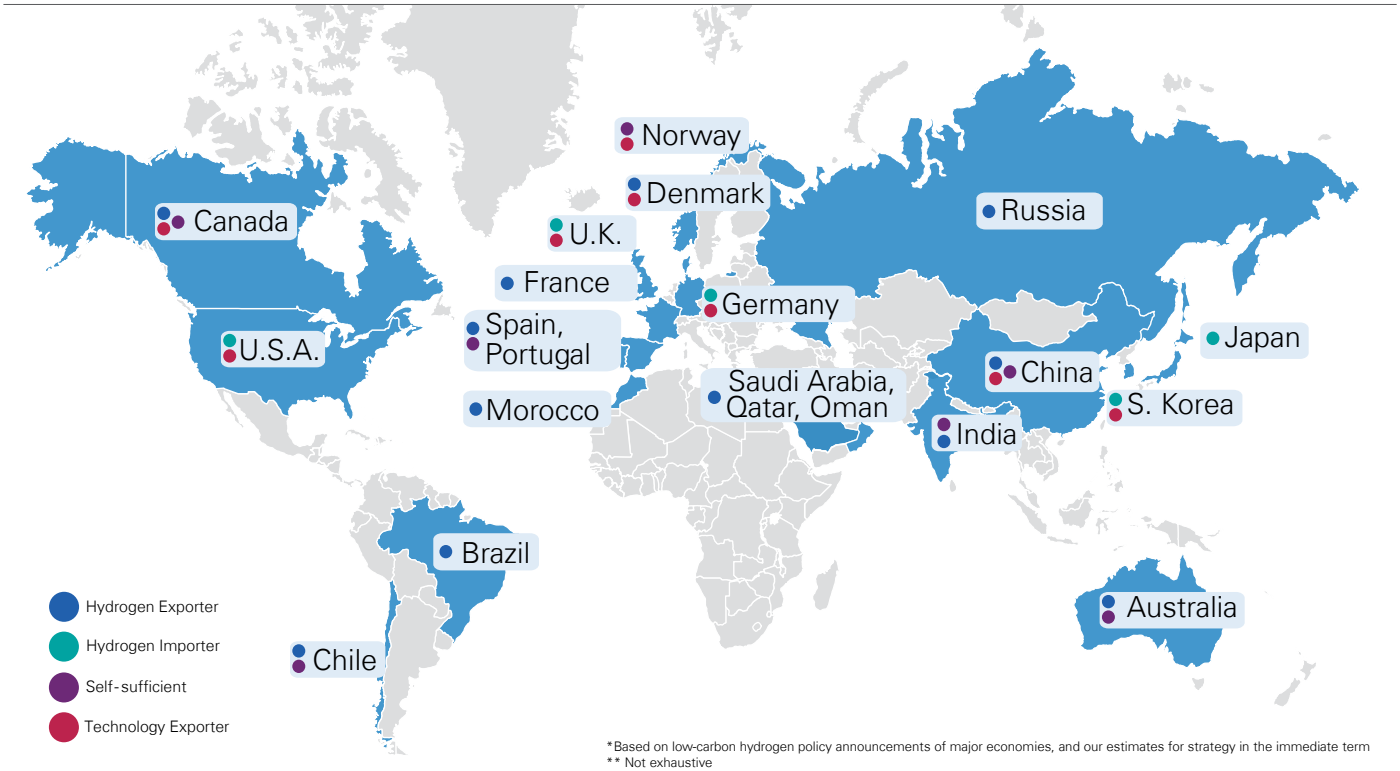
Australia is developing an export infrastructure by supporting R&D on green hydrogen and compressed hydrogen ships for transport. Australia is sending the world's first shipment of liquified hydrogen to Japan. The Australian government has dedicated over USD 500 million to build new international technology partnerships. Australian hydrogen production for export and domestic use could generate more than USD 50 billion in 2050.

South Korea has entered into a strategic agreement with Australia for import and R&D of hydrogen technologies.

Chile has moved quickly with many neighboring countries also now in the process of developing their strategies. It is planning a 25 GW electrolyser capacity by 2025 with the cheapest domestically produced green hydrogen prices (between USD1.30 and USD1.80 per kg) in the world by 2030. It is also exploring export opportunities with Netherlands and Singapore.

Germany was an early mover in Europe and helped push the EU low-carbon hydrogen strategy during its EU presidency. The national hydrogen strategy set an import target of 76 to 96 TWh worth of renewable hydrogen for 2030 and as per their national hydrogen strategy. Berlin has reserved USD 405 million for support to green hydrogen projects outside Germany.

Key global low-carbon hydrogen hotspots



*Based on low-carbon hydrogen policy announcements of major economies, and our estimates for strategy in the immediate term
** Not exhaustive

Source: KPMG India analysis

The world's largest green hydrogen project, with a 150 MW alkaline electrolyser, has been commissioned in Dec. 2021 in China to be used at an oil refinery

Based on measures observed across countries, the following major groups of movers and leaders are emerging.

Critical initiatives across strategies

Demand side movers

Public-private partnership for hydrogen usage and end-use development, Hydrogen usage obligations, Carbon costs and credits, hydrogen for transportation, hydrogen usage within public infrastructure including buildings and buses, hydrogen subsidies for end use applications

South Korea (Fuel cell) | Chile (Ammonia) | Japan (Industrial)

Technology and R&D leaders

Talent and expertise development, prioritization of R&D initiatives, emphasis on trials and pilots, R&D on innovative approaches to hydrogen generation (such as from Industrial waste, tidal energy etc.)

U.K. | South Korea | Germany

Supply side movers

Supply side contracts for difference mechanisms (ensuring hydrogen offtake prices), Increased emphasis on renewable energy generation, transmission waivers and subsidies, cross sector linkages for hydrogen production, development and harmonization of national regulations

Australia | Chile | U.K. | India

The geopolitics of clean hydrogen is likely to play out in decades. The 2020s could be the period of the big race for technology leadership, with costs falling significantly and scaling up of the infrastructure. In many locations, green hydrogen is set to compete on costs with blue by 2030.[8]

Post-2030, the higher ambition scenarios see higher hydrogen demand with another strong pull from 2035 onwards, as per WEC 2021.[9] During this period, international trade of hydrogen and derivatives could grow significantly providing further interesting prospects for RE resource rich country such as India.

> **According to IEA, nearly 320 green hydrogen production demonstration projects have been announced worldwide**

8. IRENA, 2021
9. World Energy Council, 2021