

Global Hydrogen

Policy, investment and innovation drive momentum

Climate Change & ESG
Global

- ◆ Hydrogen’s potential for a key role in economy-wide decarbonisation gathers momentum...
- ◆ ...as policy-makers in Europe, Asia and other regions align supportive policies with climate ambition
- ◆ Companies are investing in projects across the value chain and innovation in production and end-use continues apace

Despite, or perhaps because of, the COVID-19 pandemic, the cleantech market saw significant focus in 2020, spurred also by renewed EU policy focus under the Green Deal and the victory of Joe Biden in the US Presidential Election. Of the cleantech themes which performed best, hydrogen was prominent (see page 9). The global surge of interest in the hydrogen economy was, in our view, an important feature of the energy transition in 2020.

Government support Policymakers around the world have shown rapidly increasing levels of commitment to the hydrogen economy. As we enter the 2020s, and many countries ramp up efforts to meet Paris Agreement pledges or set pathways towards net-zero emissions target dates ([The climate in 2021](#), 5 January 2021), the build-out of hydrogen production and usage is increasingly being explored as a focus for decarbonising sectors across economies.

Companies drive the pace Companies in many sectors made pledges to build out low-emissions hydrogen production projects. Furthermore, commitments were also made to hydrogen infrastructure and the technologies which consume energy. We think the activity across upstream, midstream and downstream sectors of the value-chain is truly supportive of this theme.

Multi-sector innovation To meet the ambition of policy-makers and companies, technological innovation continues at companies and institutions around the world, including in as-yet-uncommercialised areas such as production from seawater, waste-to-hydrogen and applications in ships, trains, aviation, homes and industry.

HSBC Global Research published a number of notes on hydrogen last year, which kicked off with [Global hydrogen: Why the journey from grey to green is taking off?](#), 30 January 2020, and, in subsequent months, spoke with over-100 investors across global markets on this theme. Now, in advance of our **Global Investment Seminar** (25-28 January, see registration link adjacent right to register), **we are returning to the theme**. In this note, we track key developments since our global marketing push, from June through to December 2020. Meanwhile, we have also published these other notes on the theme today:

1. [Hydrogen electrolyzers](#), 13 January 2021
2. [Global hydrogen: 2020s are the roaring decade of hydrogen](#), 13 January 2021



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Related research

[Global hydrogen: Why the journey from grey to green is taking off?](#), 30 January 2020

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[The second frontier: Towards low carbon trucks](#), 26 May 2020

[Approaching sector tipping point – Hydrogen FAQs](#), 10 July 2020

[Global hydrogen: Acceleration across the value chain](#), 6 July 2020

[Can COVID-19 catalyse transport transition](#), 26 March 2020

[Global Chemicals: Green hydrogen – a NEOM deep dive](#), 10 September 2020

[The second frontier – Why the transport sector is next in tackling climate change](#), 15 January 2019

[Climate Inflection Point: Where will Biden's US re-focus?](#), 11 November 2020

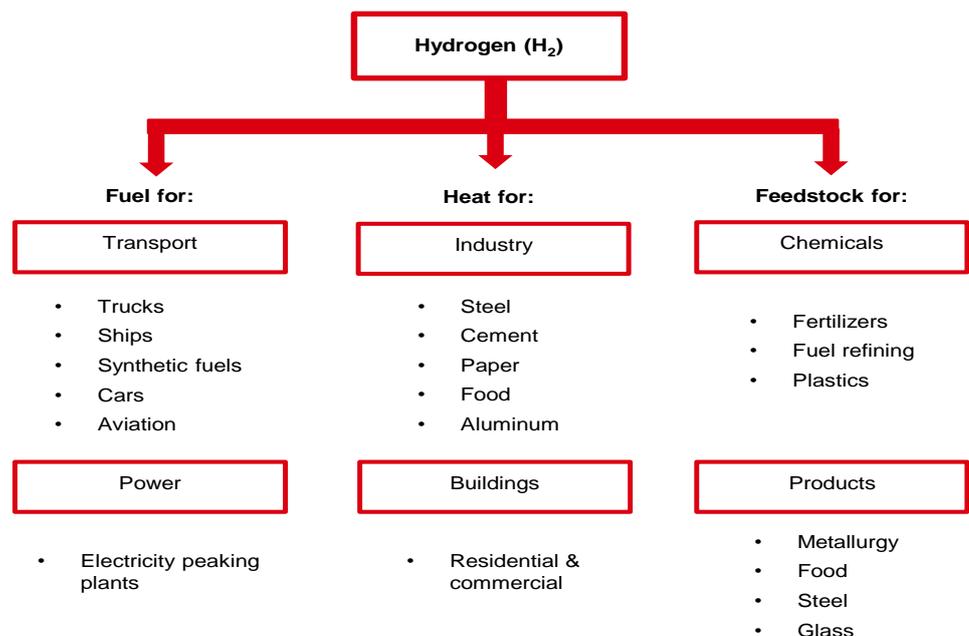
[US: Climate Inflection Point - Georgia results pave way for Biden climate agenda](#), 7 January 2021

Government and policy support

- ◆ As the hydrogen theme has gathered pace in recent months...
- ◆ ...so has supportive policy been introduced in markets around the world
- ◆ We look at a range of measures explored and introduced

As efforts to cut carbon emissions to counter climate change become more urgent, the part played by hydrogen in the transition to a low carbon economy looks set to grow significantly. Policy can play an important role in catalysing this transition – a point we made in [Global hydrogen: Why the journey from grey to green is taking off?](#), 30 January 2020. In this note a year ago we cited examples of supportive policy frameworks. Now, a year later, in this section we give details of how jurisdictions around the world have continued to develop supportive policies, particularly in the later months of 2020.

Hydrogen is seen as a potential replacement for fossil fuel energy in a wide variety of economic activities



Source: BNEF

Europe

The European Union

EU countries lead push for clean hydrogen support

In June 2020, following The European Commission's pledge to use its proposed EUR750bn recovery fund to support clean energy, six European Union countries' called for specific legislation and increased funding to support the hydrogen sector. With the EU consuming c8m tonnes of hydrogen per year, mostly produced from fossil fuels, the countries' petitioned for the need to scale up and reduce the cost of green hydrogen. One of the 6 countries, Germany, pledged EUR9bn from its COVID-19 relief package specifically towards clean hydrogen.

EU's new strategy to boost green hydrogen

The following month, the European Commission released a new strategy to scale up renewable hydrogen projects across polluting sectors. Phase one includes the installation of at least 6 GW of renewable hydrogen electrolyzers and the production of up to one million tonnes of renewable hydrogen, with Phase two by 2030 aiming for 40 GW. The EU's priority to develop "green" hydrogen and largely deploy it from 2030 to 2050, will be gradual with "blue hydrogen" playing a role.

Most EU gas grids not allowed to carry hydrogen yet

According to a survey of transmission system operators by 23 EU national regulators conducted in July, most EU natural gas grids are not yet set up to allow hydrogen to be injected, which will be needed as part of the EU's 2050 climate neutral goal. The survey found that grid rules on accepting low-carbon gases vary widely across the EU, with Germany allowing the highest reported level of hydrogen in its gas grids (c10%). While most work to increase acceptance is at an early stage, national regulators recommended that hydrogen blending limits should be at least 2% by volume.

Rules on hydrogen trade with partners

In October, the EU's Energy Commissioner said the European Union will seek to establish rules to trade hydrogen with countries including Morocco and Ukraine. The EU will also put hydrogen on the agenda in energy talks with the US, Japan and South Korea in order to scale up renewable hydrogen projects and meet their 2050 net zero goal.

New initiative targets private investments to jumpstart EU's green hydrogen market

The following month, EIT InnoEnergy SE unveiled the European Green Hydrogen Acceleration Centre programme to harness private investments and jump start the EU's green hydrogen industry, creating up to 500,000 jobs.

Germany

Germany plans for EUR 40bn climate spending

In June, the German government unveiled plans for a EUR130bn stimulus package that features at least EUR40bn of climate-related spending. Specifically, Chancellor Angela Merkel's government pledged EUR7bn for new hydrogen projects, EUR2bn for green auto innovations, EUR2.5bn for EV charging infrastructure, EUR2.5bn for public transport improvements, EUR 1bn each for green aviation and shipping programmes, EUR2bn for green building upgrades, and EUR700m for improved forest management.

German clean energy industry sees billion-euro investments but there are price concerns

The same month, German utility companies' association BDEW said the government's stimulus package could trigger EUR320bn of investments in power generation, grids, electric charging and hydrogen by 2030. Additionally, consultancy firm, Ernst & Young on behalf of BDEW, estimated this EUR320bn in investments could create c271,000 jobs in energy and related industries. However, concerned over price, the energy industry advised lower surcharges and taxes on electricity to offset fiscal shortfalls by widening mandatory carbon emissions pricing.

Hydrogen a key climate component

Meanwhile, Germany's government believed the national green hydrogen strategy adopted by the cabinet should help the country become a leader of the lower carbon economy. According to the Economy Minister, Peter Altmaier, boosting hydrogen from renewable energies such as wind and solar power will help decarbonise key German industries such as steel, chemicals and transport, as well as supporting German technology exports.

German oil refinery to build 30 MW hydrogen electrolysis plant

In August, companies involved in a hydrogen project at the Heide oil refinery near Hamburg planned to build a 30 MW electrolysis plant. With the largest electrolysis plant measuring 6MW, a 30MW plant will be a large step in the development of hydrogen. Germany is aiming for 5,000 MW of electrolysis capacity by 2030. The partners involved in the Heide refinery project, received approval for EUR30m in funding from the economy ministry and plan on providing EUR59m for a total investment of 89 million.

Frankfurt starts construction for world's biggest zero-emissions train fleet

In October, the German regional transport group, RMV, began construction of a hydrogen filling station near Frankfurt that will use hydrogen generated as a by-product of chemicals manufacturing to fuel passenger trains. This is part of France's rail transport company, Alstom's plan to deliver 27 hydrogen-powered fuel cell trains by mid-2022 to replace diesel engines. Germany's Hesse state and the federal government helped fund the EUR500m project.

Germany scraps renewable fee to encourage green hydrogen

In December, the German government waived the renewable energy fee under the EEG feed-in tariff law for electricity derived from new energy technologies in order to support renewable energy for producers of green hydrogen.

Portugal receives EUR16bn investment proposals for hydrogen energy

In July, the Portuguese Ministry of Environment and Climate Action announced it had received investment proposals for industrial production of hydrogen-based energy totalling EUR16bn. According to the ministry, the projects under discussion cover strategic areas, starting with the transportation sector. Portugal's utility EDP-Energias de Portugal, oil group Galp, and holding company REN are among the group selected consortiums.

France backs green hydrogen as part of GBP30bn green energy package

In September it was announced that almost a third of France's EUR100bn coronavirus recovery package will be directed towards greener energy policies, including green hydrogen production. With energy consumption representing c70% of France's emissions, the funds would be an opportunity for the country to spearhead low-carbon hydrogen production with the help of the solar industry. The country plans on investing a total of EUR7bn in green hydrogen by 2030.

Spain sets EUR8.9bn goal for green hydrogen

In October, the Spanish government made a plan to build 4 gigawatts of green hydrogen capacity by 2030. The programme would require an investment of EUR8.9bn within the next decade.

Energy suppliers promote a hydrogen-fuelled COVID-19 recovery plan

In June, ten of the UK's largest gas and energy companies pushed for the hydrogen sector to play a key role in the UK's economic recovery plans. The companies involved, which intend to invest GBP900m in a 'zero carbon gas grid' in the UK, believe early investments in hydrogen would drive down costs and create jobs. They urged the government to adopt an official cost reduction target for green hydrogen, mandate hydrogen ready boilers aligned to Future Homes Standards by 2025, release funds for a "full scale transition" to hydrogen networks and investigate hydrogen transport.

Scotland's GBP62m fund to support energy sector

The same month, the Scottish government announced an energy sector transition fund of GBP62m to aid in energy sector recovery post COVID-19. The fund, which will support businesses in the sector over the next five, is considering projects which support the energy transition, including hydrogen developments.

In September, ScottishPower Renewables teamed up with hydrogen tech firms ITM power and BOC to develop a green hydrogen supply chain in Scotland. The partnership's first project is to commercialise Glasgow-based production plant within the next two years. The facility would utilise wind and solar energy generated by ScottishPower Renewables to power a 10MW electrolyser, which is to be developed by ITM Power and operated by BOC.

Later in 2020, it was announced that hundreds of homes in Scotland could be the first in the world to use 100% green hydrogen as part of a new trial. 300 homes in Fife will be fitted with free hydrogen boilers, heaters and cooking appliances to test if zero carbon hydrogen could

help meet Britain's climate goals. The trial is backed by energy regulator, Ofgem, which has awarded GBP18m to SGN to develop the pioneering project. The Scottish government also supports the project with GBP6.9m.

UK government gives aid for a green whisky industry

In August, the UK government launched a new fund to help the whisky industry go green, while promising to continue to combat aggressive US tariffs. Distilleries can apply for GBP10m of research and development funding for reducing emissions in the sector. The government hopes it will encourage distilleries to test low-carbon hydrogen, biomass and repurposed waste to power their operations.

UK hydrogen development inhibited by lack of strategy

The same month, the UK chairman of the Environmental Audit Committee (EAC) warned the lack of a clear hydrogen strategy could shrink the role hydrogen plays in the UK's net zero transition. While the UK has the expertise and technical capability to scale up the development of low-carbon hydrogen, it is lagging behind other nations such as Australia, Japan, Canada and even the EU, all of which have ambitious hydrogen strategies in place, according to the comments.

Americas

Canada to announce blue hydrogen blueprint

In July, the Canadian federal and Alberta governments looked to build on existing hydrogen and natural gas production, with longer term plans for green hydrogen. Canadian city, Ottawa's strategy is to rely on a combination of blue and green hydrogen since Canada is a major producer of both gas and renewables.

Joe Biden's Climate Plan seeks a green hydrogen economy

Also in July, US President-Elect Joe Biden launched his Plan for Climate Change and Environmental Justice. This included a point which specifically commits to investing in electrolysis technologies to make green hydrogen cost-competitive with hydrogen produced by fossil fuels by 2030.

Chile set sights on green hydrogen

In November, Chile started to make plans to produce the world's cheapest green hydrogen by 2030, with 5GW of electrolysis capacity under development by 2025. The country has developed an action plan that will include a financing round of USD50m for green hydrogen projects and a task force to monitor the permitting process. The energy minister proposed the green hydrogen proposals will consist of USD200bn in investments over the next 20 years and create 100,000 jobs.

Asia-Pacific

South Korea hydrogen strategy underway

In August, South Korea announced the start of commercial production at the world's first byproduct hydrogen-based fuel cell power plant, after unveiling plans to set up the world's largest liquid hydrogen plant. The project forms a part of the South Korean government's hydrogen strategy that aims to sharply boost output of hydrogen-powered vehicles and hydrogen electricity.

South Korean President Moon Jae vowed, in December, to support low-carbon technologies backing his pledge to achieve net-zero emissions by 2050. While South Korea plans on shifting the country from fossil fuels to a renewable based system, it also prioritises green transport. The country plans to expedite its goal to having 1.13 million electric vehicles (EVs) and 200,000 hydrogen vehicles on the roads by 2025, up from 91,000 and 5,000 each at the end of 2019, and also plans to make charging batteries easily assessable to the 20 million households nationwide

Japan works to create a commercial hydrogen fuel supply chain

In October, Japan Industry Minister said the country would seek to create a commercial hydrogen fuel supply chain by around 2030. There are plans to ship liquefied hydrogen from Australia to Japan early next year for the first time, as the world's first liquefied hydrogen carrier was launched last December, 2019. The ministry is requesting a hydrogen budget of USD800m for 2020, 20% more than last year, in order to support Japan's 2017 hydrogen goal of importing 300,000 tonnes of hydrogen in 2030.

Australia-Germany partner to exploring green hydrogen exports

In September, Australia and Germany joined together to fund a 2-year feasibility study into the production, storage, transport and use of hydrogen from renewable energy. Australia's energy minister Angus Taylor believes exporting hydrogen could contribute an estimated AUS11bn per year in additional GDP by 2050. While Australia has signed other hydrogen-related agreements in the last year, the Germany partnership is the first to explore exports to a European state.

Western Australia's renewable energy hub moves forward

In October, Western Australia granted environmental approval for the first stage of their renewable energy hub focused on green hydrogen production, which could reach 26GW of solar and wind generation. The first stage includes 5GW of solar and 10 GW of wind generation. While up to 3GW of generation capacity will be used by large energy users, the bulk of the energy will be used for large-scale production of green hydrogen for both domestic and export markets.

Providence plans to develop 39 solar farms paired with hydrogen storage

The same month, Australian renewable energy investment firm Providence Asset Group unveiled plans to expand into the state of Victoria with 11 operational solar farms, in addition to the 28 solar projects in New South Wales. All projects will be paired with 30MWH of advanced storage including hydrogen and lithium-ion batteries. The company is working with the University of New South Wales to develop hydrogen storage, which will be more cost-effective than lithium batteries.

India finalises a draft for hydrogen-powered cars

In June, the Indian automotive industry moved a step closer to the commercial launch of hydrogen-powered vehicles with the government-instituted Automotive Industry Standards Committee (AISC) submitting a final draft on its regulations. Similar guidelines for electric vehicles were finalised earlier. Currently, no company sells hydrogen-powered vehicles in India, however Hyundai, the country's second largest car produce, plans to launch Nexo, a sports utility vehicle (SUV) powered by hydrogen, in the country next year.

India to ramp up solar manufacturing and hydrogen generation

In July, the Union Power Minister of India announced that the government was planning to develop 3 GW of solar module and cell manufacturing capacity in the country in pursuit of become self-reliant in the renewables space. Currently, India imports nearly USD3bn worth of solar cells and modules. The government is also interested in inviting bids for an innovative program that would involve generating solar power to generate hydrogen for city public transport.

Indian Government set to evaluate feasibility of hydrogen fuel-cell vehicles

The same month, the Road Transport Ministry of India has proposed to include hydrogen fuel cell vehicles (FCVE) to be in accordance with the Automotive Industry Standard. Additionally, they are proposing an amendment to the Central Motor Vehicles Rules for the inclusion of safety evaluations of FCVEs.

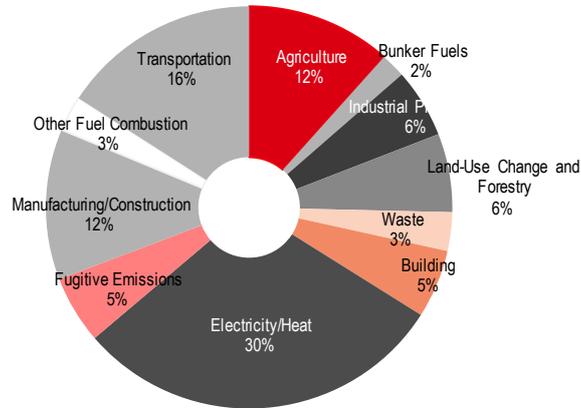
Delhi's buses trial Hydrogen-blended CNG

Later in the year, India's Union Minister of Petroleum & Natural Gas and Steel in October launched the trial run of Delhi's buses on Hydrogen-blended CNG (HCNG), which will provide clean and reliable transportation to millions of Indians. The Minister believes Hydrogen is the ultimate fuel.

Russia and Germany consider hydrogen partnership

In July, Russian and German businesses proposed linking in the construction of a hydrogen production plant, according to the German-Russian Chamber of Commerce. The two countries have tie-ups in the oil and gas sector and this hydrogen initiative would expand Russian-German energy partnership. Germany has stated it can allocate EUR2bn for such projects involving international partners, including Russia.

Potential to reduce economy-wide emissions: global GHG emissions per sector, 2017



Source: WRI, CAIT

China's energy giants cautiously explore hydrogen

In September, China's state energy producers outlined initiatives to develop hydrogen and wind power after their earnings and oil prices slumped in the first half of 2020, but their renewables projects could take years to materialise. The world's largest oil refiner, Sinopec, wants to lead China's hydrogen push, with plans for hydrogen refuelling stations alongside its petrol stations on the east coast. However, this will not be immediate and Sinopec has been vague on the scale of its hydrogen push.

New energy vehicles to make up 20% of China's new car sales by 2025

In November, sales of electric, plug-in hybrid and hydrogen-powered vehicles in China, the world's biggest auto market, are forecast to rise to 20% of overall new car sales by 2025 from just 5% now, according to the State Council. This is lower than the 25% goal mentioned last year. The State Council advocates for improvements in the technologies, construction of more efficient electric vehicle charging networks and greener vehicle outputs from automakers.

Middle East and Africa

Oman explores opportunities for green hydrogen

In July, Oman set up a green hydrogen committee. The committee, set up under the Ministry of Oil & Gas, also involves the Ministry of Technology and Communication, companies operating in the oil and gas sector, and academia, in order to study opportunities in the green hydrogen sector.

JV launched to pair 4GW with green hydro project in Saudi Arabia

The same month, ACWA, Air Products and NEOM joined as equal partners in their joint venture project to develop a green hydrogen project in Saudi Arabia, using up to 4GW of solar and other renewables as its power source. The project will cost USD5bn and will be expected to run in 2025 to produce 6650 tons of hydrogen per day and 1.2m tons of green ammonia each year.

Corporate activity

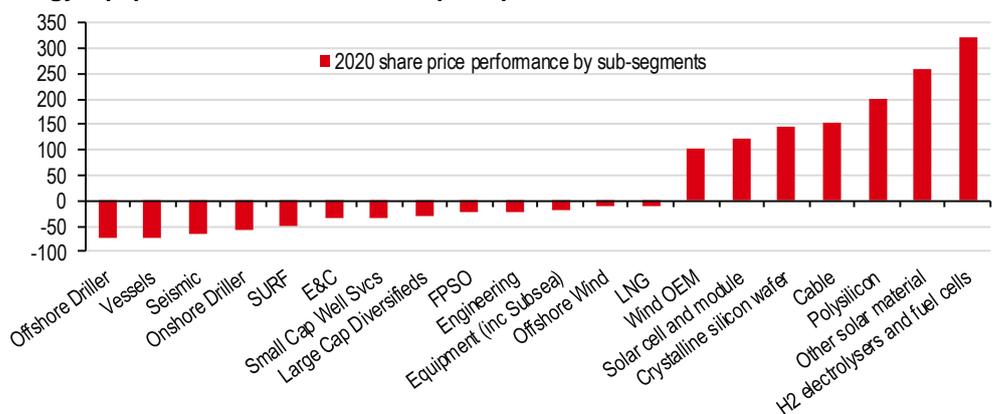
- ◆ Companies around the world are responding to climate challenges and the emergent policy agenda ...
- ◆ ...with investments across the hydrogen value chain
- ◆ We see important corporate commitments in production, infrastructure and end-use technologies

Corporate activity picked up dramatically across the clean hydrogen value chain in 2020, particularly in the second half. In this section, we look at some of this newsflow, across the value chain:

- ◆ 'upstream' – relating to hydrogen production
- ◆ 'downstream' – hydrogen infrastructure
- ◆ 'downstream' – end-users of hydrogen

Many companies in the hydrogen value chain reached new valuation peaks in 2020, with the chart below demonstrating its popularity among cleantech themes, during a year when investments in climate change technologies supported strong share price performance. In [ESG and Climate: Strong price performance in 2020](#), 18 December 2020, via our *HSBC Climate Solutions Database* we reported that companies with >10% of revenue from climate themes, have on an equal-weighted basis outperformed a global equity benchmark by 20.3%.

Energy equipment and services share price performances in 2020



Source: Refinitiv Eikon

Upstream

UN Green Hydrogen Catapult to halve production costs

The world's largest energy companies joined the UN Green Hydrogen Catapult to bring down the cost of hydrogen production. The project aims to drive down the cost of hydrogen to USD 2/kg by 2026, approximately half its current price. The target is 25GW of green hydrogen production by 2026. The project cites a study by business group the Hydrogen Council, which estimates a USD 2/kg cost of hydrogen will allow markets to sustain a profitable hydrogen production industry.

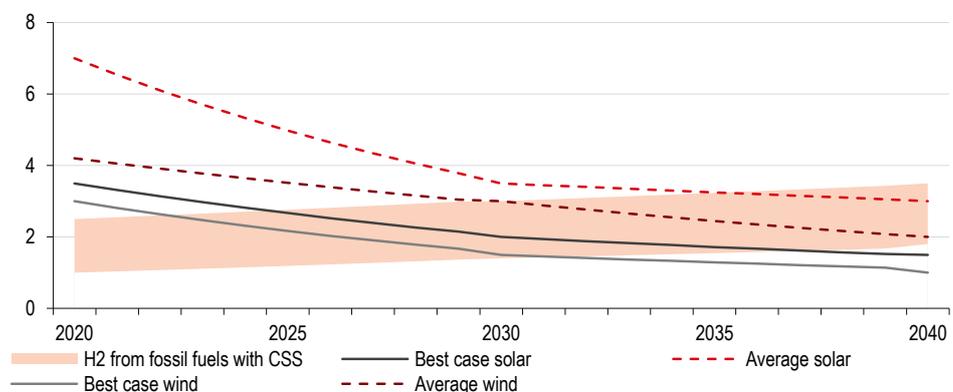
Repsol unveils Spanish green hydrogen plan

In June, Spanish energy giant Repsol revealed plans to construct a net zero emissions synthetic fuel plant, based on green hydrogen. Repsol stated EUR 60m will initially be invested in the project, as it combines forces with Petronor, a leading Spanish industrial centre, and the Energy Agency of the regional Basque government. The facility, based in Spain, is expected to be fully operational within four years with planning underway in 2020. It will aggregate CO₂ captured from a nearby Petronor refinery with green hydrogen as raw materials for the process.

Japan's Chiyoda says hydrogen pilot project begins to fuel power plant

The same month, Chiyoda Corp and its partners – Mitsubishi Corp, Mitsui & Co and Nippon Yusen – announced their hydrogen project initiated production of clean fuel for the gas turbine power generators of Toa Oil Co, in Kawasaki. The consortium, working on the pilot project since 2016, utilises the organic chemical hydride method which will rely on 210 tonnes/year of imported hydrogen from Brunei.

Future cost trajectory for hydrogen production (USD/kg)



Source: IRENA

Equinor to build hydrogen plant with carbon capture in Britain

Equinor set out plans in July to construct a blue hydrogen plant with carbon capture and storage. The Norwegian company aims to reduce CO₂ emissions by approximately 900,000 tonnes per year, predominantly through substituting gas with hydrogen at the Saltend Chemicals Park in Hull, north-east England. The project titled H2H Saltend would make the plant the largest in the world to use CCUS with a 600MW auto thermal reformer to create hydrogen from natural gas. A final investment decision is expected in 2023 with production commencing from 2026.

Bosch opens hydrogen-compatible fuel cell pilot plant

In July, Bosch opened a fuel cell pilot plant in Wernau. The system comprised three fuel cell devices for stationary applications augments the extant power supply of the Wernau plant with the stated twofold effect of reducing CO₂ emissions and further driving the development of such decentralised energy systems.

Shell and Eneco's offshore wind farm to include floating solar and hydrogen production

Meanwhile, Shell and Eneco launched the CrossWind joint venture aiming to develop an offshore wind farm 18.5km off the coast of the Netherlands showcasing a number of technological demonstrations including green hydrogen as well as floating solar and short-term battery storage. The subsidy-free offshore wind farm Hollandse Kust (Noord) is planned to be

operational by 2023 with 69 turbines from Siemens Gamesa resulting in an installed capacity of 759 MW, generating a minimum of 3.3 terawatt hours annually.

Germany's Westküste 100 green-hydrogen project secures funding

In August, Germany's Westküste 100 project received EUR 30 million by the German Federal Ministry of Economic Affairs and Energy. The project with a total budget of EUR 89 million will be the first large-scale hydrogen project in Germany. The following ten partners are to deliver the Westküste 100 project: EDF Germany, Holcim Germany, OGE, Ørsted, Raffinerie Heide, Stadtwerke Heide, Thüga and thyssenkrupp Industrial Solutions, together with the Region Heide Development Agency and the Fachhochschule Westküste (West Coast University of Applied Sciences).

Wind Power to Run Giant Hydrogen Plant at BP Oil Refinery

In November, two of Europe's largest energy companies, BP Plc and Orsted A/S, joined forces to develop an industrial-scale electrolyser to produce green hydrogen at BP's Lingen refinery, Germany. The project remains at a conceptual stage, with plans to construct a 50 megawatt electrolyser from North Sea wind farms to replace 20% of natural gas-based hydrogen at the refinery. Zero-emissions production is expected to begin in 2024.

Equinor, RWE join Dutch hydrogen project

In December, German utility RWE and Norwegian oil and gas firm Equinor joined an initial phase of a Dutch project to produce "green" hydrogen by using offshore wind power. The NorthH2 project, launched in February by Dutch Gasunie, Groningen Seaports and Shell, will use electricity to produce green hydrogen from water.

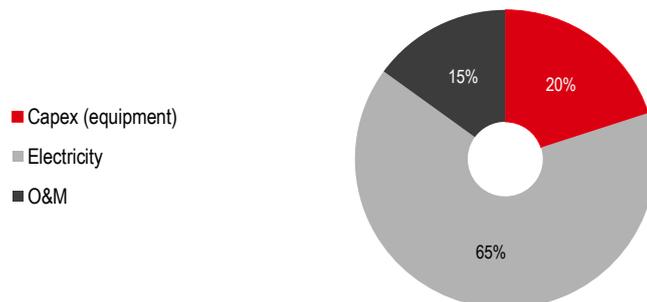
Enel Green Power, NextChem planning green hydrogen project in US

The same month, Enel Green Power North America Inc. (EGPNA) and NextChem, energy transition subsidiary of Maire Tecnimont S.p.A, signed a memorandum of understanding to promote the production of green hydrogen via a new electrolyser in the US. The project aims to convert renewable energy from EGPNA's solar plants in the US into green hydrogen to be supplied to a bio-refinery. The new electrolyser is expected to commence operation in 2023.

Green hydrogen from Hydro-Quebec to be used in biofuels production

And also in December, Hydro-Quebec, Canada's largest electricity producer, announced plans to build an electrolyser with capacity of 90MW. The facility will generate 11,100 metric tonnes of green hydrogen annually to supply the RCV biofuel plant in the Greater Montreal Area. Hydro-Quebec, the sole shareholder of the electrolysis plant, will invest around CAD 200 million (USD 156.5m/EUR 129m) in the project.

Typical cost split of green hydrogen production in EU



Source: Hydrogen Europe

Midstream

Hiringa and Mitsui jointly pursuing hydrogen projects in New Zealand

In June, green hydrogen provider, Hiringa Energy, entered a Strategic Alliance Agreement with trading enterprise Mitsui & Co in June, under the joint aim of creating a viable domestic hydrogen economy and export opportunities in New Zealand. Under the alliance, Mitsui will contribute to multiple hydrogen projects initiated by Hiringa, such as Hiringa's nationwide

refuelling network, construction of stations throughout 2021, and a joint venture with Balance Agri-nutrients.

Hyundai partners with gas giants for hydrogen cars in Australia

As of August, two gas companies will partner with Hyundai to supply refuelling infrastructure for hydrogen-powered cars in Australia. Over the past year energy infrastructure giant, Jemena, and Wesfarmers-owned Coregas have been in talks with Hyundai over supplying green hydrogen for a refilling station in Sydney's Macquarie Park.

Italy's Snam sets 2040 carbon target in clean energy drive

In November, Italian energy infrastructure group, Snam, set a carbon neutral target by 2040 and plans to invest EUR 7.4bn, over the next four years, to prepare its network for hydrogen and the transition to cleaner energy sources. The company stated its aim for a 50% cut in carbon emissions by 2030, up from the previous target of 40%. Snam, which earns the majority of its revenue through gas transportation in Italy, aspires to transport fully decarbonised gas in its network by 2050. A pilot study in November achieved a hydrogen blend of 10%.

Snam and Linde join forces on European projects

The following month, Snam partnered with US-German industrial gases group, Linde, in a joint venture to develop clean hydrogen projects across Europe. The companies will collaborate to promote key technologies along the hydrogen value chain and invest in clean hydrogen projects, specifically areas of production, distribution, compression and storage. Of note, Linde has the largest liquid hydrogen capacity and distribution system globally.

New Japanese industry group

Also in December, several large Japanese companies joined forces to establish the Japan Hydrogen Association with the aim to create a national supply chain. The creation of a commercial hydrogen fuel distribution chain reinforces the national commitment to becoming carbon neutral by 2050. The industry group, co-led by the chairman of Toyota, Sumitomo Mitsui Financial Group Inc and Iwatani Corp is expected to provide policy recommendations to the government in February 2021.

Downstream

Toyota to launch fuel cell venture with Chinese auto firms

In June, Japanese automaker Toyota launched a hydrogen fuel cell joint venture (FCRD) in collaboration with five Chinese companies. The Beijing-based venture includes FAW Group, Dongfeng Motor Corporation, Beijing Automotive Group, GAC and Beijing SinoHytec. It amounts to a YEN 5.02 billion investment (USD 46 million), with Toyota holding a 65 per cent stake.

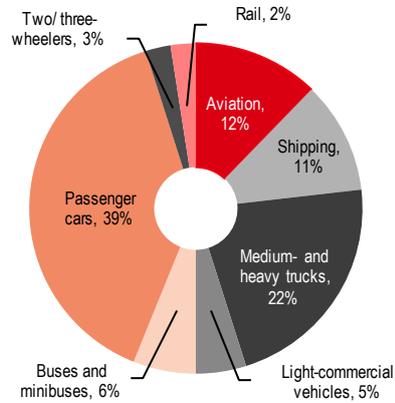
Gazprom and Rosatom will start producing "clean" hydrogen in Russia

In July, Russia's government set out a roadmap for the future which includes hydrogen as a key feature of its exports. In accordance with government hydrogen strategy, Russian gas giant Gazprom will start producing green hydrogen from 2024. This year will see Gazprom test prototypes for a methane-hydrogen-powered turbine, whilst also studying the efficacy of hydrogen as a fuel in gas turbines, gas boilers and vehicles. Rosatom, Russian nuclear power major, seeks to further reinforce the hydrogen drive through testing applicability to fuel trains from 2024.

Chinese automakers announce targets to raise hydrogen vehicle sales

Chinese automakers announced new targets in September, increasing sales of hydrogen fuel cell vehicles following official announcements in September that the government would set out a package of policies supporting such vehicles. SAIC Motor, China's biggest automaker, which enjoys partnerships with Volkswagen AG and General Motors Co, stated plans to sell over 10,000 hydrogen fuel cell vehicles by 2025. Furthermore, commercial vehicle maker Beiqi Foton Motor aims to sell 4,000 hydrogen vehicles by 2023, and 15,000 by 2025.

CO₂ emissions by transport type (2019) – hydrogen has potential to replace oil derivatives in many of these



Source: IEA, Energy Technology Perspectives 2020

BHP invests in hydrogen and carbon capture for Chinese steel

In November, Australian mining company BHP invested AUD 35 million (USD 48 million) at the steel mills of China Baowu Group with a focus to decarbonising the steel value chain. Steelmaking accounts for 10% of global greenhouse gas emissions, contributing twofold from chemical reactions in manufacturing and carbon-intensive power sources. BHP's initiative aims to reduce Baowu's scope 3 emissions – greenhouse gases generated by customers - through carbon capture and storage, and hydrogen technology.

Technological innovation

- ◆ Innovation remains crucial in accelerating the build-out of a global hydrogen economy
- ◆ New technologies are being developed in hydrogen production...
- ◆ ...and in consuming sectors such as transport, heating and power

Hydrogen is an abundant element, and given its potential to replace fossil fuels in a range of uses, it has great potential as a zero-emission fuel. When burned or converted into electricity, hydrogen gas does not produce any emissions at all. However, *production* of hydrogen today is not emissions-free because it largely relies on unabated natural gas and coal. Furthermore, the infrastructure needed to ensure hydrogen can be used more broadly than the current narrow range of uses (with the majority going to diesel manufacture and ammonia creation, much of this for fertiliser) is lacking.

Innovation continues apace, across many sectors and across the value chain – we believe this will be crucial as the hydrogen value chain is built out, supported by better technologies and improving costs.

Hydrogen production

Medical, municipal, plastic and agricultural waste to hydrogen

In July 2020, Ways2H Inc., a global producer of renewable hydrogen, and Ford, Bacon & Davis, a company that specialises in energy facility engineering, procurement and construction, have partnered to design and build waste-to-hydrogen facilities in the US. The two companies plan to build the first facility in California, with a pipeline of additional projects to in 2021. The approach converts some more challenging formats of waste, including medical, municipal, plastic and agricultural waste into renewable hydrogen, with a net zero-carbon footprint.

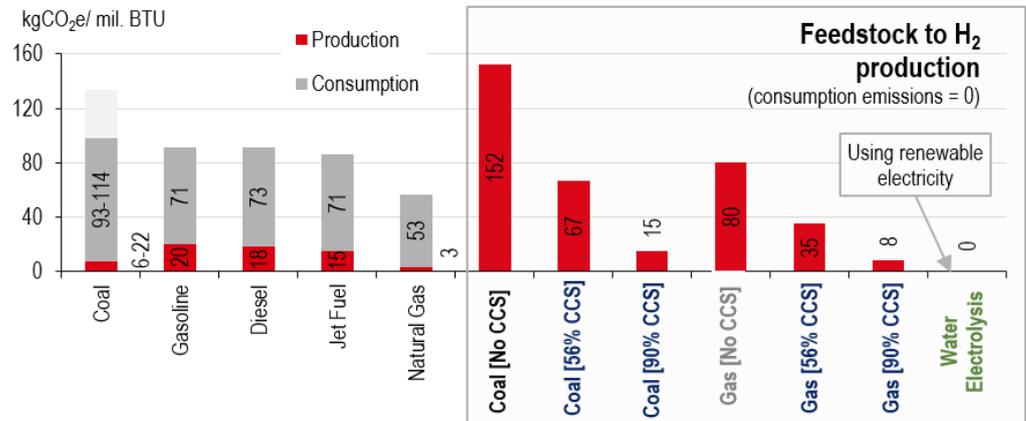
Wind to seawater to hydrogen

In the same month, Neptune Energy joined the European Clean Hydrogen Alliance promoting the European Union's hydrogen strategy to become carbon neutral by 2050. Neptune's PosHYdon initiative seeks to integrate 3 energy systems in the Dutch North Sea; offshore wind, gas and hydrogen, thereby creating the world's first offshore green hydrogen plant. The project will utilize offshore wind turbines to power the hydrogen plant 13km offshore, which will convert the seawater to demineralized water before hydrogen via electrolysis.

Porsche backs climate-natural fuels project in Chile

In December, Porsche backed plans for a green hydrogen production plant in Chile. The 'Haru Oni' pilot project is expected to yield the world's first integrated, commercial industrial-scale plant for making synthetic climate neutral fuels (eFuels). The project will produce 130,000 litres of eFuels by 2022 in the pilot phase, 55 million litres of eFuels per year by 2024, and around 550 million litres of eFuels by 2026.

Hydrogen not always lower-carbon...emissions from fossil fuels and hydrogen types (black (or brown), grey, blue and green)



Source: HSBC, IEA, US EIA, GEA, UNFCCC; BTU= British thermal unit; 1 mil. BTU = 0.025 tons of oil eq. (toe)= 1055 mega Joules (MJ); Note: Capture rate of 56% for natural gas with CCS refers to capturing only the feedstock-related CO₂, whereas for 90% capture rate CCS is also applied to the fuel-related CO₂ emissions; consumption emissions from end-use conversion into energy (burning / other process); production emissions from production, processing (incl. refining), transmission, storage and distribution. Includes fugitive methane emissions as well; emissions for H₂ do not cover transmission and distribution related emissions. Note: black hydrogen refers to production from coal, although some commentators distinguish between black as being from hard coal and brown being produced from lignite.

Transport

Duel-fuel water tanker

Low emissions vehicle company ULEMCo produced the world's first hydrogen-fuelled water tanker in partnership with Yorkshire Water, in June last year. The 7.5 tonne tanker, which was converted from a standard truck, can run on hydrogen or diesel fuel. The unit will reduce one-third of carbon emissions, which could further be reduced if refuelled with green hydrogen.

Liquid hydrogen refuelling technology

Later, in December, Linde and Daimler Truck AG signed an agreement to jointly develop the next generation of liquid-hydrogen refuelling technology for fuel-cell-powered trucks. With their collaboration, the partners aim to make the refuelling process with hydrogen as easy and practical as possible.

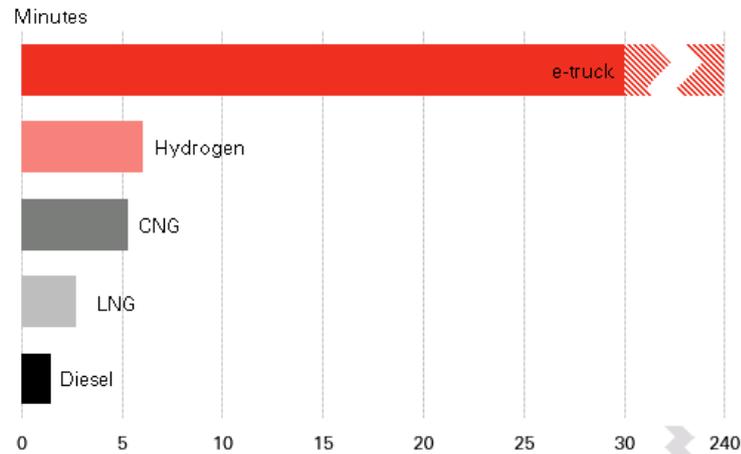
Chile's hydrogen powertrain mining project

In August, CSIRO Chile, ENGIE and Mining3, planned to develop hybrid power train modules in Chile for mining, replacing conventional diesel ones with ones made up of batteries and hydrogen fuel cells. The project, HYDRA, could have future expansion possibilities to the wider mobility sector.

French plans for hydrogen as a clean shipping fuel

From trains to ships, in September, French energy behemoth Engie SA partnered with rocket-maker ArianeGroup to develop hydrogen production infrastructure and promote hydrogen as a clean fuel for the shipping industry. The tie-up comes in line with European nations increasing subsidies for research and development into cleaner and cost-effective hydrogen production. The companies aim to leverage expertise in liquefied natural gas and hydrogen systems to reduce liquefaction and equipment costs.

Refuelling time to travel 400 miles in a HGV – hydrogen not as fast as fossils but much faster than battery recharging



Source: Bloomberg NEF
* E-truck includes Tesla Motors statement Note: E-trucks based on Tesla Motors statement and Bloomberg NEF calculation assuming an efficiency of 0.285 miles/kWh and a 350kW, which is 30 minutes range.

40-passenger regional hydrogen aircraft

And the same month, now to aviation, where MagniX partnered with Los Angeles start up Universal Hydrogen to create a 40-passenger regional aircraft with carbon-free, hydrogen-fuelled electric powertrains. The plan is to provide an electric propulsion system in the 2-megawatt class for each wing, powered by hydrogen fuel cells. If the project succeeds, it is intended that the technology can be applied to the development conversion kits for a wider family of aircrafts. Meanwhile, Aerospace giant Airbus unveiled plans for creating the first hydrogen-fuelled passenger planes, estimated to be in service by 2035.

Heating and energy

Microsoft tests hydrogen fuel cells at datacentres

In July, Microsoft successfully completed a pilot study using a 250kW hydrogen fuel cell system to power a row of datacentre servers for 48 consecutive hours, in line with the company’s ambition to be carbon negative by 2030. The experiment was part of Microsoft’s ongoing efforts to eradicate its dependency on diesel-powered backup generators which accounts for less than 1% of Microsoft’s overall emissions. Although Microsoft reportedly uses its backup generators less than once a year, hydrogen production facilities could also provide refuelling services for hydrogen-powered vehicles, as well as supplement electricity demand surges.

Hydrogen heating for homes

In August, Britain’s National Grid planned a GBP10m project in the north west of England to test how hydrogen could be used to heat homes which currently use gas. National Grid hopes construction, in the north west of England could start in 2021, subject to approval by energy regulator Ofgem, with trials to begin in 2022.

From black hydrogen to blue in Japan

The following month, Japan made plans to demonstrate the viability of gasifying brown coal, to generate blue hydrogen, transport it by sea to Japan and use it in a cogeneration plant to generate electricity and heat. The carbon dioxide generated in the process is captured and stored underground to make the process carbon-neutral.

Research

Green hydrogen could be cost competitive by 2030

In July, a study claimed that production of green hydrogen using renewable power for electrolysis could be cost competitive by 2030, according to research firm IHS Markit. The analysis found that the cost of producing green hydrogen had fallen by 50% since 2015, and

stands to drop by another 30% by 2025 as the scale of projects, standardisation of manufacturing processes and investment flows into hydrogen increase. Economies of scale, developments of dedicated renewables facilities to increase load factors of electrolyzers and continued cost reductions for renewables will all play a part in reducing costs.

**Land and permitting only
obstacles to renewables' big
green hydrogen push**

In August, it was claimed that Europe's renewables sector stands well positioned to deliver the huge scale of growth required to power a green hydrogen economy, but issues surrounding land and permitting need to be tackled if the sector is to reach full potential, according to Solar Media. Proper legislation pertaining to permitting and land availability needs to be put in place for the hydrogen economy to be successful.

**Government inaction and
investment shortfalls hinder
global green hydrogen push**

The same month, a report published found that investment shortfalls and government inaction are impeding on the growth of green hydrogen globally, potentially creating a shortfall by 2030 according to the Institute for Energy Economics and Financial Analysis (IEEFA). IEEFA concludes that Europe, Australia and Asia were leading the hydrogen charge, backing the majority of new green hydrogen projects that have emerged. However, ongoing uncertainties surrounding financing, scale and government action could create roadblocks for the growth of green hydrogen.

**Hydrogen and carbon
capture key to net-zero US
electricity by 2035 ambition**

A report released by California-based Energy Innovation in September 2020 found that the US can generate affordable electricity without producing emissions by 2035 through deploying hydrogen and utilising carbon capture technology. The report highlights five scenarios for the US to generate 100% clean energy in 15 years, without raising power costs. Three rely on the deployment of green hydrogen technology and two rely on capturing CO₂ emissions from existing power plants. This timeframe is in line with Joe Biden's ambition in his July 2020 Climate Change Plan.

**Hydrogen is a major
investment opportunity**

In November 2020, a number of leading European energy companies and trade associations teamed up to form a new Renewable Hydrogen Coalition aimed at increasing renewable hydrogen production and use across the continent. The coalition brought together WindEurope and SolarPower Europe, and received support from the Breakthrough Energy initiative backed by Bill Gates. To mark its launch, it published a report stipulating renewable hydrogen represents a substantial investment opportunity of EUR 550-700bn within the next decade, with abatement potential of 450-550 metric tonnes of CO₂, equivalent to 10% of Europe's annual emissions.

Disclosure appendix

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