



2022

March

Stepping up the Pace of Hydrogen Development



Webinar White Paper

The Al-Attiyah Foundation



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The latest Al-Attiyah Foundation webinar, titled Stepping up the Pace of Hydrogen Development, was held on 7 March and brought together world-renowned experts to discuss the role environmentally friendly hydrogen can play in the ongoing energy transition and how using the gas in more urban activities can help nations achieve their net-zero carbon emissions targets.

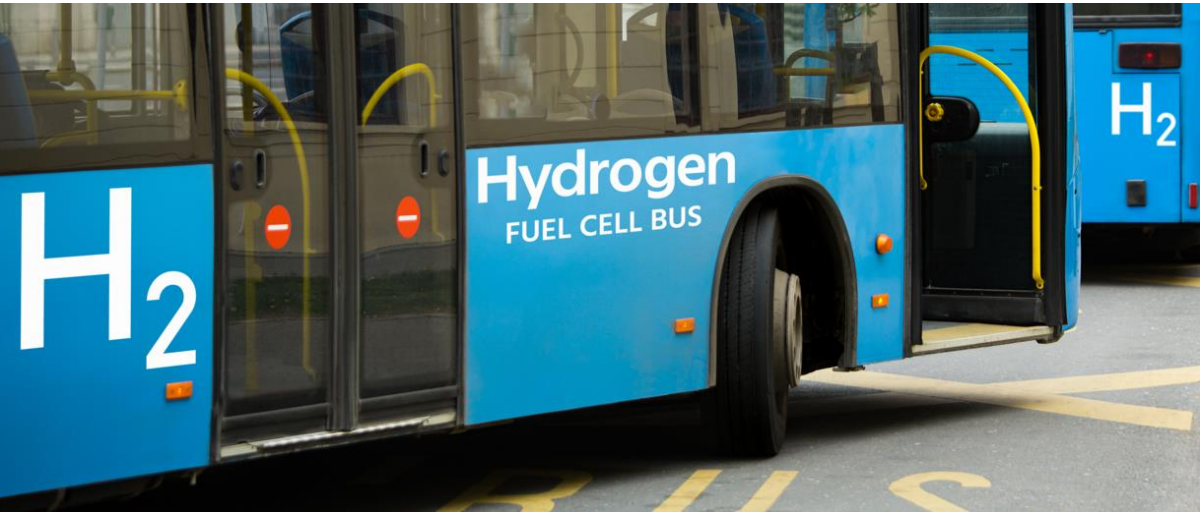
The International Renewable Energy Agency (IRENA) forecasts hydrogen will account for nearly 12% of global energy use by 2050, providing a \$2.5 trillion investment opportunity through to 2050 for utilities, equipment makers and others seeking to reduce their emissions.

While widespread demand for clean hydrogen will likely emerge only in the mid-2030s, during the current decade there will be a race to develop technologies to produce and deliver green hydrogen at industrial scale.

WEBINAR WHITE PAPER

H.E. Abdullah Bin Hamad Al-Attiyah founded the Foundation as a platform for knowledge exchange and support for the global community in the quest towards a sustainable energy future.

The Webinar Series, which began two years ago, is a crucial networking and learning opportunity in the calendar of industry CEOs, Members, and Foundation Partners.



Hydrogen production will grow exponentially over the coming decades, with the lightest element known to humanity pivotal to slowing global warming. Yet reducing costs to make the gas commercially competitive versus fossil fuels remains a significant challenge.

There are three methods to manufacture hydrogen. So-called brown or grey hydrogen is made from methane via steam reforming and produces carbon emissions. Blue hydrogen uses the same process but also deploys carbon capture and storage technology to prevent the carbon dioxide (CO₂) produced from entering the atmosphere. For green hydrogen, renewable energy-powered electrolyzers split water - H₂O - into its component elements. Green hydrogen is both a carbon-free fuel, as burning it only produces water, and a means to store excess energy generated by renewable power plants.

The US energy department's Energy Earthshots programme, launched in June 2021, aims to reduce the cost of "clean" hydrogen by 80% to \$1 per kilogram within a decade from around \$5-6/kg for green or blue hydrogen currently. Such a goal is "remarkably ambitious", said Charley Rattan, Offshore Wind and Hydrogen Corporate Advisor at Charley Rattan Associates.

"Not all investors are thrilled by the prospect of making a big investment and then seeing the cost of the



Charley Rattan, Hydrogen Corporate Advisor, Charley Rattan Associates

offtake be so substantially reduced in such a short period of time," he said.

The annual global hydrogen market was worth \$187.5 billion in 2020 and will grow at a CAGR of 6.6% to reach a value of \$286.8 billion in 2027, according to MarketWatch.

Demand for steel, iron and ammonia, whose production requires hydrogen, will help drive this growth, said Mr. Rattan.

Hydrogen consumption will surge to up to 800 million tonnes annually by mid-century from 115 million tonnes currently, Mr Rattan said, citing Reuters forecasts. In an audience poll, 64% of respondents said mixing hydrogen with natural gas would be the first major industrial use for green hydrogen, while 27% opted for steel manufacturing and 9% for aluminium production.

Another audience poll revealed that 100% of respondents believe effective carbon-pricing regulations were the key to unlocking the hydrogen economy. ([Hydrogen Shot - Department of Energy](#))

Banks are wary of financing green hydrogen projects due to “inability to secure the kind of offtake agreements that are needed to give investors confidence that hydrogen production is going to have a buyer,” warned Jeffrey Beyer, Managing Director of Zest Associates.

“The offtake issue has been one that's really challenged lenders to invest in hydrogen or even for companies to make a solid investment case for hydrogen. Another issue is the technical capability of bankers - we saw this with renewable energy, especially offshore wind, where there was a lack of ability to accurately assess investment risk because these projects were first of a kind or relatively novel. Banks hadn't lent for this type of investment before.”

In offshore wind, state-run green investment banks were created to make the first investments and solve this quandary. The same could happen for green hydrogen, Mr Beyer predicted.

In a third audience poll, 60% of respondents said it would take more than 10 years for hydrogen production to become cost competitive for power generation

without incentives, while 40% predicted it would take a decade to achieve this milestone.

“Hydrogen is quite expensive at the moment and that's not something that's going to facilitate a big growth for the business,” said. Mr Rattan. “The cost needs to come down. There's various means of doing that for offshore wind, we use the principle of clustering very effectively and can see that happening with hydrogen. We will get the cost down... by clustering, scale and perhaps innovation.”



Electrolyser costs have fallen 90% in the past decade or so, Mr Rattan said, noting prices were forecast to decline a further 75% in the next 5-6 years.

Green hydrogen production is following a similar trend to that of battery development, said Josh Carmichael, Wood's Vice President of Hydrogen. At first, the focus for battery manufacturers was at the cell chemistry level before shifting to improving batteries' energy management systems and operational factors, he explained. Green hydrogen production is undergoing a similar process as industry protagonists explore the merits of the differing types of electrolyzers and the water systems they require before optimising their operational and maintenance strategies to reduce the total cost of hydrogen production.

"Once you've got that sorted, then you move into the value of the hydrogen, not so much the cost in the same way that batteries now provide frequency and stability services for the (electricity) grid," said Mr. Carmichael, noting standardisation and modularisation are driving cost reductions in electrolyser manufacturing.

"It's getting to that bigger block size from one or two megawatts to five or 10. It's similar to the wind industry, where the turbines grew to two, five, 10 megawatts because that's where you get the scale."

Other factors will be critical in determining whether hydrogen costs can be reduced to \$1-3 per kg. These include transportation, whether as hydrogen or converted into ammonia. Should hydrogen production facilities be sited adjacent to where the hydrogen will be used, for example?



Mr. Josh Carmichael, Vice President of Hydrogen, Wood

"If you only focus on the electrolyser stack size, you miss the bigger picture," said Mr Carmichael.

Mr. Beyer highlighted the input costs involved in green hydrogen production, not just electrolyser hardware but also renewable electricity prices. Photovoltaic (PV) solar electricity costs fell 85% from 2010 to 2020, according to IRENA (Renewable Power Generation Costs in 2020 ([irena.org](https://www.irena.org/))).

“Our foot needs to stay on the gas, so to speak, in terms of investing in renewable energy to reduce the costs (further),” said Mr. Beyer.

“Another opportunity is around vertical integration, which was especially powerful for reducing the cost of solar power. We co-located silicon mines with panel producers in China and were able to achieve enormous cost reductions. I can see a similar type of approach happening in the hydrogen sector around electrolysis by co-locating the electrolysis process very near to the production site of renewable energy. There are losses when you transmit electricity across long distances.”

SAUDI TAKES THE LEAD

Saudi Arabia’s ACWA Power, U.S. industrial gas company Air Products¹ and state-owned NEOM are equal partners in the kingdom’s \$5 billion Helios Green Fuels hydrogen project. Helios will use 20 MW of onsite electrolyzers - powered by nearby wind and solar farms - to make 650 tonnes of green hydrogen daily. This which will then be converted into ammonia, producing 1.2 million tonnes annually.

The project is on track to begin commercial operation by 2026, said Driss Berraho, ACWA Power’s Director of Business Development for

Renewables and Green Hydrogen. He downplayed the prospects for blue hydrogen to play a meaningful role in decarbonising carbon-intensive industrial processes, noting carbon capture does not fully capture the CO₂ produced in steam reforming.

“The technology may be available, but to scale up and bring it to a level of commercial viability will require substantial investments. I am not entirely convinced that this is the best allocation of capital - it could be directed straight into addressing the long-term solution, which is fully decarbonized hydrogen produced by renewable power,” said Mr. Berraho.

“Green hydrogen costs may go down the cost curve much faster than people expect and displace blue hydrogen before it even becomes a viable option. That increases the risk of stranded assets.”



[1. Air Products, ACWA Power and NEOM Sign Agreement for \\$5 Billion Production Facility in NEOM Powered by Renewable Energy](#)

He also highlighted how green hydrogen can help create a truly global green energy market, noting how particular countries such as Germany were struggling to achieve their renewables targets due to a lack of renewable resources. Instead, Germany, for example, could fund green hydrogen plants in locations with abundant renewable capacity such as North Africa and the Middle East, importing the green hydrogen for use in local electricity production.

Although the challenges to achieving cost-competitive green hydrogen are sizeable, they are surmountable, and with both government and industry determined to make good on their pledges to decarbonise the coming decades should see the gas become an integral part of our energy systems.

GUEST SPEAKERS

Moderator:



Mr Stephen Cole,
International Television
Host & Moderator

Speaker:



Mr Charley Rattan,
Wind & Hydrogen
Corporate Advisor,
Charley Rattan Associates

Speaker:



Mr Josh Carmichael,
Vice President of
Hydrogen, Wood

Speaker:



Mr Driss Berraho,
Director - Renewables
& Green Hydrogen,
ACWA Power

Speaker:



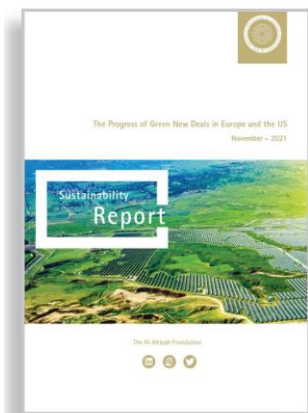
Mr Jeffrey Beyer,
Managing Director,
Zest Associates

Have you missed a previous issue? All of the Al-Attiah Foundation’s publications, including the Research Series and White Papers, can be found on the Foundation’s website at <http://www.abhafoundation.org/publications>



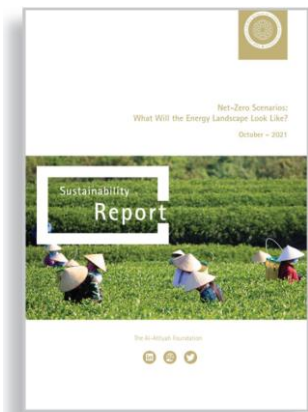
December - 2021
[Consensus Forecasts on Long-Term Demand for Fossil Fuels](#)

As the world begins to recover from the COVID-19 pandemic, a fundamental change is unfolding in the global energy system. Climate policy and advancing energy technologies are having an increasing impact alongside the short-term pandemic impacts and the usual long-term effects of economic growth and demographics.



November - 2021
[The Progress of Green New Deals in Europe and the US](#)

Governments in Europe and the USA want the recovery from the Covid-19 pandemic to be the springboard for environmentally and socially progressive policies. The EU has proposed the ‘European Green Deal’ and ‘Fit for 55’, while the administration of President Biden has put forward a ‘Green New Deal’ and the strategy of ‘Build Back Better’.



October - 2021
[Strategies for Sustainable Production and Consumption of Natural Resources](#)

An increasing number of countries have committed to reach net-zero carbon emissions, usually between 2050-70. Any remaining emissions of carbon dioxide or other greenhouse gases would be cancelled out by increased forestry or other methods to remove atmospheric CO2.



Our partners collaborate with The Al-Attiyah Foundation on various projects and research within the themes of energy and sustainable development.





The Al-Attiyah Foundation

☎ Tel: +(974) 4042 8000,
Fax: +(974) 4042 8099
🌐 www.abhafoundation.org

📍 Barzan Tower, 4th Floor,
West Bay.
✉ PO Box 1916 Doha, Qatar

🐦 AIAttiyahFndn
🌐 The Al-Attiyah Foundation
📺 AI-Attiyah Foundation