Ceres Power Holdings PLC

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Hydrogen investment 101: what's all the excitement, how will it work, which companies are involved?

Shares prices in hydrogen-focused companies have finally begun to make serious headway this year as governments have begun to set out more concrete zero-carbon targets.

While environmental campaigners, ecologists and many others have long been stressing the importance of decarbonisation, the financial market's attention has only really begun to tune in to the discussion this year as governments around the world have set out more concrete targets.

As we're only in the early stages of the hydrogen journey there's still likely to be significant opportunities for investors who want to dive deeper in this sub-sector.

Many of these aim to meet or beat the aim of the Paris Agreement to keep the global average temperature rise "well below" 2°C above pre-industrial levels.

This means it is vital for the global economy to shift from fossil fuels and to low- or zero-emissions energy.

The EU, in July this year, provided a big kick up the industry's backside with its Hydrogen Strategy plan to encourage green hydrogen production and consumption, which includes targets to increase installed electrolysis capacity 4gigawatts (GW) in 2024 from 140 megawatts (MW) in 2018, then up to 40GW by 2030.

Hydrogen capacity of 1GW is equivalent to 40,000 to 100,000 tonnes per year of hydrogen capacity, depending on the load factor for the electrolyser.

With the UK having pledged to reach net-zero greenhouse gas emissions by 2050, the government and industry have both stressed the likely crucial role of hydrogen.

Price: 680

Market Cap: £1.17 billion

1 Year Share Price Graph

Share Information

Code:		CWR
Listing:		LSE
52 week	**High**	**Low**
	795	**206**
Sector:		**Renewable Energy**
Website:		**www.cerespower.com**

Company Synopsis:
Ceres Power Holdings Plc is a world-leading developer of next-generation solid oxide fuel cell (SOFC) and electrochemical technology.

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Last year the Committee on Climate Change predicted that between 6GW and 17GW of electrolyser capacity will be required in the UK by 2050, depending on energy demand and utilisation rates, implying the country will need to build up to 567MW of electrolysis per year for 30 years.

Last month, the UK government said it is working on the "detailed and specific policy levers" that would be needed to be able to deliver what it said would be "a world leading hydrogen market", while Germany has a stated goal of installing 5GW of green hydrogen by 2030 and an additional 5GW by 2040, France to 6.5GW by 2030, and South Korea one to watch with a target of getting to 15GW by 2040.

It's not just governments, energy network operator National Grid recently said it was entirely credible that hydrogen gas "could be the solution to many of the hardest parts of the transition to net-zero", particularly in long-distance freight, shipping and heavy industry.

At this stage, it may be worth going back to school for a quick catch-up on the chemistry.

Quick chemistry lesson

Sitting at the top left of the periodic table, hydrogen is the simplest and one of the smallest and lightest molecules in the universe.

While often thought of as a form of renewable energy, hydrogen is not really a fuel, as it takes energy to isolate it in the first place, but it has excellent characteristics as a carrier or store of energy, which makes it well placed for a number of applications.

For those who don't remember their anodes and cathodes from GCSE's or O-level science, the process of electrolysis uses electricity to split water into hydrogen and oxygen. A fuel cell can reverse this process, creating energy from hydrogen and oxygen.

Not all hydrogen is truly 'green', though, as the gas created is only as clean as the method by which it was produced.

These low-carbon credentials are grouped under three broad categories:

'Grey' hydrogen is the currently dominant form of hydrogen manufacture, but as it is made using fossil fuels such as from coal gasification or steam methane reforming, this is not really green fuel at all.

'Blue' hydrogen is where the CO? emitted during the production of grey hydrogen is sequestered via carbon capture and storage (CCS), so producing energy with pretty low emissions, with around 90-95% of CO2 captured.

'Green' hydrogen, made by electrolysis using renewable energy, is the only version of the fuel that is free of CO2 at the point of use and at the point of production.

Green hydrogen is also seen as potentially very useful for balancing the electricity grid as it can be created by fast-response electrolysers at a time of high renewable energy generation and used as power in fuel cells when power is in shorter supply.

Global production today is around 70mln tonnes per year from direct manufacturing processes, with 98% of that produced from fossil fuels, mostly natural gas, according to analysis by Liberum, with around 2% from low or zero carbon processes, ie blue or green or biogas.

How hydrogen can be used

Renewable energy from wind, solar and hydro is already being used to power homes and businesses, while batteries are already being used to power cars, with hydrogen currently only a small piece of either pie.

For a major step up in decarbonisation, hydrogen will almost certainly be needed. It has applications in energy generation, transportation, industry and heating - especially where electrification is not feasible, such as when a large amount of energy is needed.

While much of the focus in recent years has been on renewable energy, for some energy requirements electricity is not a viable option for technical and economic reasons and so hydrogen is a potential solution to fulfil some of these other uses.

Transport is a key example, as compared to heavy electric batteries, fuel cells using hydrogen have benefits in range and weight, as well as faster refuelling times. Currently, a hydrogen fuel cell car takes a couple of minutes to refuel for a range of around 300 miles, while an electric battery car requires at least a half an hour for around a 100-mile range and even a Tesla supercharger takes 75 minutes for a full charge.

Weight and range are even more of an issue in some other parts of the transport industry, such as industrial transport and aerospace.

Airbus, for example, this year switched its development focus from batteries to hydrogen as it feels battery technology will not advance quickly enough to adapt to large aircraft, which it expects to fly by 2035. How big would the battery need to be to fly a jumbo jet across the Atlantic?

Green hydrogen can be used for heat and power for buildings through existing infrastructure contributing to a small part of the fuel mix within natural gas networks. Green hydrogen could be created by using excess renewable electricity, storing green hydrogen created through electrolysis, and producing power back into the grid cleanly.

Moving from transport to heavy industry, some of the high-temperature heat needed for industrial production, such as metalworking and glassmaking, would be well suited to hydrogen as it burns at over 2,000°C in open air, while hydrogen is a more natural solution than batteries for some industries due to its greater energy density.

Companies involved the hydrogen revolution

Companies are already starting to benefit at all stages of the hydrogen market, from creation and supply of the fuel, to those businesses manufacturing the cells and components, and those that deal with the end-user operations, plus all those involved in the rolling-out of the infrastructure.

ITM Power PLC (LON:ITM) is a specialist in electrolysis based on proton exchange membrane (PEM) technology. It offers various sizes of electrolyser unit, from one 'stack' that can produce 270kg of hydrogen per day, a two-stack and three-stack model, all the way up to a modular system where each module has a 2MW capacity.

This technology has been adopted by Royal Dutch Shell PLC (LON:RDSB) which as part of a collaboration with ITM where is rolling out hydrogen refuelling stations using the technology for passenger and commercial vehicles.

Last month, as part of a new partnership with Scottish Power, chemicals giant Linde's BOC arm and ITM, was launched to create clusters of green hydrogen refueling stations, starting with a first based around a 10MW electrolyser near Glasgow.

Hydrogen fuel cells could widely be split into three types: polymer electrolyte membrane, alkaline, and solid oxide. Ceres Power Holdings PLC (LON:CWR) has developed a ceramic technology that forms the basis of highly efficient solid oxide fuel cells, both more affordable and more robust.

The AIM-listed group sells this SteelCell technology under a licence model and it has attracted heavyweight partners including Germany's Bosch and China's Weichai, Miura in Japan and **Doosan in South Korea**.

Also, by reversing the process within a fuel cell, Ceres solid-oxide technology could be used for electrolysis of green hydrogen or synthetic fuel production from renewable electricity. The company said earlier this year it is investing in £5mln over the next year and a half in the development of this technology, which some think could lead to the lowest cost production of green hydrogen.

AFC Energy PLC (LON:AFC) makes alkaline fuel cell systems and elecrolysers, with its fuel cells and AlkaMem membrane also boasting the ability to reduce costs through being able to use lower quality and less expensive hydrogen sources.

Its products include the HydroX-Cell fuel cell, which comes in a larger model for industrial uses and with lower grades of hydrogen; and a compact Hydrox-Cell model more suitable for vehicles and other mobile applications; the H-Power a zero-emission electric vehicle charging system; and a commercialisation agreement to produce zero-emission hydrogen fuel from natural gas.

With unprecedented investment coming into the sector, AFC said **2020 has seen a key turning point for hydrogen** and said its anticipates making "large strides forward benefiting from a wider technology platform, growing project pipeline across key target markets and new enquiries from strategic partners".

As green hydrogen need to be manufactured, some analysts stress that the zero emissions power sources and the wind- and solar-focused companies that provide the power to electrolyse green hydrogen are going to be the main investment opportunity for investors. This might range from the likes of energy companies focused on green energy, like SSE PLC (LON:SSE) and Drax Group PLC (LON:DRX), to renewable energy funds, including Greencoat UK Wind PLC (LON:UKW), from NextEnergy Solar Fund PLC (LON:NESF), Foresight Solar Fund Ltd (LON:FSFL).

For another angle, catalytic converters group Johnson Matthey (LON:JAMT) recently held a day of presentations to show off its **capabilities in green, blue and grey hydrogen**, boasting that it currently has a 40% market share in hydrogen produced by catalytic converters and aims to be a big player in production of green hydrogen from its proton exchange membrane technology and expertise in fuel cells and closed-loop recycling.

Elsewhere, industrial gas companies like Air Liquide, Linde PLC (LON:NYSE:KLIN) and Air Products & Chemicals (NYSE: APD) are already getting in on the hydrogen act.

In electrolysis, Norway's Nel ASA is one of the largest producers in the world, with alkaline and PEM technology and exposure to the hydrogen refuelling station market, where there are government targets to increase the current stock from circa 400 worldwide to over 5,000. It has a contract with controversial US electric truck firm Nikola to provide electrolysers and refuelling stations as it rolls out its fleet across the US.

On top of that, in fuel cells, notable companies include Korea's Doosan, Sweden's PowerCell, US trio Ballard Power Systems Inc (NASDAQ:BLDP), PlugPower Inc (NASDAQ:PLUG) and FuelCell Energy Inc (NASDAQ:FCEL), while in electrolysis, industrial titan Siemens has a PEM offering and ThyssenKrupp an alkaline technology.

What the analysts say

Today hydrogen remains a "minimal part" of the economy, but energy analysts at RBC Capital Markets said in a new note this week: "we expect hydrogen to play a meaningful role in fuel supply to multiple sectors, including heavy-duty trucking, marine, steel, cement, chemicals and potentially even aviation over time".

Noting that blue hydrogen today costs around US$2-2.5 per kg, versus green hydrogen in the US$2.5-6/kg range, a $50-per-tonne carbon price scenario, the analysts expect blue and green costs will fall to around $1.5/kg and $2.6/kg, respectively by 2030, with an even higher carbon price swinging the economics towards green over blue.

"That said, for green hydrogen, around 75% of the total cost of production comes from power generation, and with both solar and wind costs deflating, costs could fall further over time. While some companies (e.g. Shell) have pushed the merits of hydrogen for some time, growing investor & societal pressure to de-carbonize all sectors has put the emphasis on many corporates, from energy producers to consumers, to collaborate in order to accelerate development over the next decade."

The EU's plan set out this year was "a huge step forward for the industry and, if delivered along with investment elsewhere in the sector, could solve the chicken and egg dilemma of supply/demand in the hydrogen economy", said analysts at Berenberg.

With each tonne of current hydrogen production resulting in 10-19kg of CO2, they said electrolysis can potentially eliminate these emissions through creating green hydrogen. "That is the long-term goal. However, other production methods, notably blue hydrogen (produced with carbon capture and storage) will likely dominate the transition over the next five to 10 years.

"We estimate a total potential capex opportunity for electrolysers of US$137-239bn over the next 10 years, increasing to US$1.2-2.1trn by 2050.

"In the near term, it is likely that most of this will be missed as end-markets take time to adjust to hydrogen and competing production methods also gain a share of the market. However, it is clear that there will be a huge market emerging over the next 15-20 years as hydrogen spreads beyond the traditional supply/demand pathways and into the wider economy."

Following its 2020 energy transition conference, UBS this week said one of its key take-aways was that with national emissions reductions plans coming thick and fast, if the international focus remains on getting anywhere near these targets "then we are going to see increasing focus on clean hydrogen as the critical technology", especially in sectors which cannot easily switch to electricity as a direct energy source.

There was also a useful rule of thumb from electrolyser company Nel, which said that for green hydrogen to be competitive with grey hydrogen, i.e. hydrogen which is produced today through methane reformation, it needs to get to a production cost of around $2 per kg or lower.

On the difference between different fuel cell and electrolyser technology, Liberum noted that alkaline technology has lower capital costs and better energy efficiency than PEM electrolysers, but has a bigger physical footprint and slower start-up times.

PEMs can respond to fluctuations in energy inputs, which makes them better able to synchronise with variable renewable energy systems, with electrolyser capex costs of around US$1.5-2mln per MW currently versus alkaline below US$1m/MW for big projects.

If by 2050 global hydrogen demand reaches 550mln tonnes per year, as envisioned by the Hydrogen Council, analysts at Liberum said that, assuming electrolysers have a 70% energy efficiency and a load of 80%, this would translate to an annual hydrogen production rate per 1MW of electrolysis of 146 tonnes.

If all of the 2020 hydrogen demand was fulfilled by electrolysers, the capital stock would have to be almost 50GW and to support a hydrogen market demand that is forecast to be 8x bigger in 2050, the electrolyser stock would have to be circa 3,700GW.

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