Weightmans

Hydrogen

Part of the energy mix and achieving net zero

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Introduction

Where does hydrogen fit in the wider energy mix? Wind, solar and nuclear power tend to grab the limelight but in order to achieve net-zero carbon emissions a balanced approach is going to be required. There is no silver bullet. In this article Jim Jordan, Partner and Professor Joe Howe from the University of Chester, consider the role that hydrogen can play in a balanced energy transition. They look at a case study in the North West of England that brings together key industry and academic players to boost the local economy and make strides in developing the technology required in order to develop the hydrogen economy. They also take a look at hydrogen from an international perspective and consider some of the barriers that need to be overcome to help us get to net-zero carbon emissions.

The energy mix has never been more topical, perhaps even more so given how the coronavirus is impacting our planet, industries and even nature outside our back doors. Many countries have already signed up to achieving net-zero carbon emissions, some binding, some simply targets. It will be interesting to see how the coronavirus impacts the move to net-zero. It may and probably should speed up the transition but there is a risk that budgets for doing so will have disappeared in the short to medium term at least. A direct impact of coronavirus has been the postponement of the COP26 United Nations climate change conference which was due to take place in November in Glasgow. By the time it takes place in 2021 it may be that we will have a better understanding of the impact of the Coronavirus on global economies, but we must remember that climate change too is a threat to humanity and needs to be tackled. Notwithstanding the impact of the coronavirus, how are we going to achieve net-zero carbon emissions? Is there one silver bullet? The simple answer is, no.

The energy mix is broadly the combination of different energy sources a country or region uses to meet its energy consumption needs. The energy mix varies vastly by region and depends on a number of factors including the density of the population, the nature of the environment and whether it is heavy industrial, rural, heavy on infrastructure and transport and the availability of finite and infinite energy sources.

Anyone with even half an eye on the news will be aware of the merits and concerns of wind (onshore and offshore), solar, biomass, nuclear and some other energy sources. The same goes for the “dirty” sources of energy such as coal and gas. However, the capability of hydrogen playing a significant part in the energy mix seems under-played. There seems to be fundamental suspicion when it comes to hydrogen, possibly linked to safety concerns, possibly linked to pricing. In this article our intention is to consider the role that hydrogen can play in the wider energy mix and indeed help us work towards net-zero carbon emissions.

Hydrogen economy

As we work towards net zero carbon emissions we have to consider all technologies and processes available to us in order to sustain and support domestic and industrial energy needs. Hydrogen can be used as a low carbon (although note not necessarily carbon-free) fuel in various circumstances. The combustion of hydrogen releases only clean water and so a whole economy is evolving around that particular fuel to help to serve our energy needs.

Hydrogen can be used in manufacturing processes such as for chemicals and iron and steel. It can more widely be used in the transportation sector and has the potential to transport renewable energy long distance and store it long term.

As it stands the primary uses for hydrogen are fertiliser production and oil refining. Not particularly comforting as we head to net zero, although important industries in their own right!

According to Wikipedia, in 2019 almost all hydrogen production was from fossil fuels, and it emits 830 million tonnes of carbon dioxide per year. This needs to change and can change. Back in May 2019 the Committee on Climate Change published a report suggesting the need to develop a hydrogen economy to service demands for some industrial processes, for energy-dense applications in long distance HGVs and ships, and for electricity and heating in peak periods. It stated that, by 2050, a new low-carbon industry is needed with UK hydrogen production capacity of comparable size to the UK's current fleet of gas-fired power stations.

The role of Government?

The UK Government has now legislated for the delivery of net zero emissions and announced some financial support packages (although subject to the economic consequences of the coronavirus pandemic) including providing for investments in hydrogen and low carbon technology in industry. Government has acknowledged that unprecedented levels of investment are needed in low carbon infrastructure services and technological innovation, which includes hydrogen production, bioenergy with carbon capture and storage, and direct air carbon capture and storage.

We have seen what Government initiatives and incentives achieved for the wind and solar markets, and how the removal of such initiatives can slow the market down. Government has a crucial role to play in the hydrogen economy and wider move to net zero. Overall, the Clean Growth Strategy sets out a comprehensive set of policies and proposals that aim to accelerate the pace of 'clean growth'. Much of the strategy refers to industrial schemes such as industrial energy efficiency schemes, decarbonisation and energy efficiency and other industrial opportunities, clearly demonstrating the importance that business and industrial relations will have on our road to net zero. One of the key actions of the Clean Growth Strategy is to work with industrial clusters (see below).

Furthermore, the low carbon hydrogen supply competitions promoted by the Government have helped in the acceleration of the development of low carbon bulk hydrogen supply solutions. The white paper for industrial strategy (Industrial Strategy: building a Britain fit for the future) sets out a long term plan to boost the productivity and earning power of people throughout the UK. The Industrial Strategy sets out Grand Challenges to put the UK at the forefront of the industries of the future and focus on global trends including clean growth.

However, the Government does not solely hold the key to control the move to net-zero. Government can inevitably impact the viability of projects offering different technologies, but it is industry that can push through change, developing the technologies and ultimately bringing down costs.

The role of hydrogen for clean energy?

Hydrogen is a chemical element that exists naturally. It offers a way to deliver low carbon energy because when it is burned it doesn't produce CO2, just water and heat. Hydrogen could provide clean energy for our domestic use, businesses and transport networks. If the hydrogen produced is from low carbon sources, or the carbon emissions created from it captured, hydrogen could help eliminate the largest sources of carbon dioxide emissions in the UK.

The key to the use of hydrogen is that it is a flexible energy source. The North West Hydrogen Alliance helpfully identifies how hydrogen technology can be deployed across the UK including:

- Power – balancing the energy system by using renewable energy to produce hydrogen by electrolysis which is injected into the gas network for heat or transport, or stored for future use (power-to-power or power-to-gas).

- Heat – using the existing gas network, hydrogen can be used as a heat source (see references to HyDeploy).

- Transport – plug in electric vehicles are becoming ever more popular. However, the infrastructure around them and the quick moving technology is still relatively new. Hydrogen can be used as a fuel, with a growing network of hydrogen refuelling stations. In hydrogen vehicles hydrogen reacts with oxygen in a fuel cell, making electricity to run the car. The only by-product of this process is water vapour.

- Storage – hydrogen can be stored as a liquid or a gas, in large quantities and for long periods of time. This helps to address the variable demand for power. Hydrogen can also be transported in pressurised tanks or bottles or be stored and used in fuel cells, which generate electricity.

The Energy Networks Association recently listed the net-zero transition as a key theme around which future innovations must be centred. In particular it recommends that businesses begin actively developing networks and products which are both hydrogen-ready and capable of supporting the wider array of green gases.

Regional case study

For the energy mix to work it must be reiterated that no single technology can get us to net-zero. Wind power is limited by geographic restrictions and the need to maximise the utilisation of the wind (although we note that improving technologies are providing for larger, more efficient and more flexible (e.g. floating offshore wind turbines) projects). Solar power has similar restrictions, although again improving technology is enabling solar farms to be installed in areas that were not viable five years ago. Then, just taking the above two examples, there is the need to get the power produced from the point of origination (possibly offshore in the North Sea or on some remote farmland) to the point of use, minimising parasitic losses. There is a whole separate infrastructure requirement around delivery alone.

The North West Hydrogen Alliance (NWHA) is making big strides maximising the benefits and use of hydrogen and the huge opportunity that hydrogen energy represents. Chair of the NWHA, Professor Joe Howe, could not be more passionate about the use of hydrogen and how hydrogen can be a lynchpin for growth, boosting the North West's economy and becoming a magnet for inward investment. Furthermore, there is scope to export the skills and lessons learned to other industries, regions and countries including a tried and tested supply chain needed to implement projects on a true industrial scale.

Bringing together industry leaders Atkins, BOC, Cadent, Costain, Peel Environmental, INOVYN, Shell and the University of Chester, the NWHA aims to put the North West at the forefront of the UK's hydrogen journey. According to the NWHA studies show the development of a major hydrogen cluster could deliver £17 billion in Gross Value Added for the North West, creating nearly 6000 jobs.

Cadent's HyNet programme, based on the production of hydrogen from natural gas, is a 'first of its kind'. This hydrogen could be used in industry, homes and transport across the North West. Carbon dioxide produced from this process, and from other industry in the region, would be captured and transported to soon to be depleted gas reservoirs in the East Irish Sea for storage.

Cadent has also been given the green light for the first live trial of blended hydrogen and natural gas for domestic gas customers in the North of England through the HyDeploy programme. If successful, the trials would build support for a much wider roll-out including via HyNet.

The region has already been recognised by Government as a potential industrial cluster as part of its Industrial Clusters mission arising from the Clean Growth Strategy (see above).

Barriers to success

It won't be easy or cheap. As with most things the route to implementation and industrial / national scale roll-out is not straightforward. There are various issues to consider and address in the coming years including:

- The public perception around change more widely and a concern that hydrogen is not green in the same way that solar or wind power is.
- Infrastructure needs to be delivered and updated to allow for high-volume implementation of the hydrogen economy. **The supply and use of hydrogen will require networks to adapt and meet the challenges of new markets and the commercial arrangements that will sit behind them.**
- Regulation needs to be introduced to facilitate the mass roll-out of the hydrogen economy and clarifying how hydrogen technology and storage requirements sit with other competing technologies.
- Technology needs further and more extensive testing, in part to address the public perception concern, in particular in respect of carbon capture and storage.
- The need to use 'blue' hydrogen from cleaned up natural gas before a wider supply of 'green' hydrogen can be achieved, although this should also enable supply chain development and the implementation of regulatory frameworks necessary for green hydrogen to be more widely rolled out in the future.

Despite some barriers there are some solid business opportunities arising from the hydrogen economy with estimates that tens of thousands of jobs and billions of pounds of investment can be delivered.

A global outlook

The scale of development must be considered at a global level. Economies of scale will facilitate the implementation of a hydrogen economy and whist regional and national initiatives are crucial to that, it is the global initiative that will enable projects to succeed. The **International Energy Agency** issued a report back in June 2019 emphasising the need for hydrogen to become a global energy source and a significant enabler of a clean, secure and affordable energy future. Mission Innovation is a global initiative of 24 countries and the European Commission (on behalf of the European Union) with members committing to seek to double public investment in clean energy research and design and engage with the private sector, fostering international collaboration. One of the 'Innovation Challenges' of Mission Innovation is to "*accelerate the development of a global hydrogen market by identifying and overcoming key technology barriers to the production, distribution, storage, and use of hydrogen at gigawatt scale*".

What is clear is that there needs to be collaboration on an international scale in order to achieve a cost competitive hydrogen value chain. We set out below examples of some truly international projects:

Australia - A massive clean energy project aiming to produce green hydrogen powered by up to 5 GW of solar and wind generation capacity was recently unveiled for Western Australia. Hydrogen Renewables Australia joined forces with Siemens to develop the Silyzer electrolyzer at the Murchison project. The **Murchison project** is set to be developed in stages including a demonstration phase providing hydrogen for transport fuels, an expansion to blend hydrogen with natural gas in the nearby Dampier-to-Bunbury pipeline and a larger expansion to produce hydrogen for Asian markets, notably Japan and South Korea.

Canada - Based on collaboration and investments made by both the public and private sectors in past decades, Canada has a strong hydrogen and fuel cell sector. Canadian companies have been involved in developing hydrogen technology including the world's first hydrogen fuel cell commuter trains now operating in Germany and in early heavy truck and marine projects in California.

Germany – Back in October of last year the German Economy Minister proposed creating a European and international certification for hydrogen technologies, exploring ways to market those technologies and seeking partner countries.

Japan – At the Karuizawa G-20 forum held in 2019 officials from Tokyo, the United States and European Union signed a joint statement declaring their intent to cooperate toward the emergence of mainstream hydrogen and hydrogen fuel cell technologies. This extends to (i) cooperation on the application of technologies and coordination on harmonisation of regulations, codes and standards and (ii) the study and evaluation of hydrogen's potential across sectors including its potential for reducing both CO2 emissions and other emissions.

USA – California in particular has an interest in hydrogen projects given aggressive decarbonisation targets and being the location of some of the highest profile technology developers in the World. There are other hydrogen projects planned for the USA including a project in Utah that would use 30% green hydrogen in 2025 and 100% green hydrogen by 2045. The **840MW Intermountain Power Project conversion** will require three key technologies, first to make hydrogen from renewable power, then to store the hydrogen in nearby caverns and then to convert the hydrogen to electricity.

Conclusion

It is without doubt that these are exciting times for the global energy markets. There seems to be a genuine push to solve or at least address the energy crisis and move to net-zero carbon emissions. There is no simple answer and a balanced view needs to be taken in terms of (i) the technologies currently being used and those being proposed and (ii) a realistic timetable for fully implementing technologies and the necessary infrastructure for them. No one knows the true extent of the impact of the coronavirus on global economies but one way or another we will become cleaner and greener through collaboration on a national and global scale.

Research for new technologies and collaboration with industry and academia has never been more important. With some help from Government initiatives, the likes of the North West Hydrogen Alliance and other research bodies and industry members are working together to test, develop and roll out hydrogen projects whilst seeking to address concerns ranging from public perception issues to cost and everything in between.

It is inevitable that hydrogen has a major part to play in the energy mix. It offers flexibility for use during transition periods to new technologies and the ultimate objective of being green in itself, where it can be produced using renewable energy. It can also boost the economy by attracting new talent and upskilling workforces as well as exporting knowledge and established supply chains. An inclusive and collaborative approach needs to be considered in which suppliers and sub-suppliers of technology, gas and electricity companies and wider business, policymakers and academia all pull together to find and implement solutions to achieve net-zero carbon emissions.

Jim Jordan is a partner at Weightmans with extensive experience working on domestic and international power transactions, primarily in the renewables sector. Professor Joe Howe is the Executive Director of the Thornton Energy Institute at the University of Chester and is Chair of the North West Hydrogen Alliance.

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If you have any questions or would like to know more please contact:

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