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The digital foundation for hydrogen economy

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TECHNOLOGY: A successful hydrogen economy requires a complex infrastructure and its stability will depend on a strong digitalised system.

A reliable and stable hydrogen economy in the UK will require robust digital systems to support the complex and interdependent systems needed for hydrogen production, distribution and utilisation.

The UK Government's Industrial Decarbonisation Strategy sets the goals for a reduction in carbon emission of two-thirds by 2035 and 90% by 2050. The time has come to set detailed pathways to establish the means of reaching this destination.

It is clear that hydrogen has a critical part to play. The simplest and most abundant element on earth, it is an excellent store and carrier of energy, with three times the energy per unit of mass of petrol. It has low energetic volume density so more of it must be transported to deliver the same energy (three times as much compared to natural gas).

Hydrogen also offers some advantages over other green energy sources, we are not dependent on the wind blowing or the sun shining to harness its energy.

It can be stored and used where needed without conversion into an intermediary format (such as batteries) when climactic conditions do not suit. On the flip side, the majority of hydrogen generation schemes are still energy intensive.

The importance of hydrogen in this bigger UK picture is highlighted by the fact that the estimated "glidepath" figures suggest one-third of carbon reductions can be achieved through energy efficiency, one-third via carbon capture, utilisation and storage (CCUS) and one-third through the use of hydrogen.

Put simply, hydrogen is an essential part of the mix. We need to deploy it as an alternative fuel source, or we will not hit the targets.

Crucially, a zero-carbon future requires a mixed economy of all the options available including the expansion of existing renewables, the introduction of hydrogen at scale, new energy efficiency measures and carbon capture.

Mother Nature has handed this fuel to us on a plate, it is now up to us to find ways to create, store, distribute and use it as efficiently as possible. And it is hard to understate the importance that digitalisation will play in these future activities.

The bigger picture

Harnessing the full opportunity that hydrogen offers is dependent on creating a viable hydrogen economy in the UK. This is dependent on also moving to greener generation methods, such as zero-carbon electrolysis, powered by renewable energy sources.

Getting there will be a challenge and reducing cost is paramount to establish a commercial market.

To create an environment in which stable and affordable costs can be achieved, it is essential that a strong hydrogen value chain is established and, to a certain degree, standardised, and just as importantly developed nationally with a holistic perspective.

This is where a digital approach will set the right foundation for integration.

Foundations for success

The UK offers an interesting case study for global hydrogen efforts. Here we can show a microcosm of project types including local, regional and clusters, as well as multiple generation processes and a wide variety of CCUS approaches. This is coupled to ambitious targets and a level of funding, with more still needed.

Another advantage we have in the UK is our experiences and existing assets from North Sea wind power and other sectors – which boast a leading digital infrastructure.

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By harnessing this deep experience and knowledge, together with the substantial research being undertaken at UK universities, the UK is well positioned to lead the way in creating a thriving hydrogen infrastructure.

Indeed, the UK could well set itself up as a best-practice example of how to plan, fund, build, connect and run a national hydrogen economy. Yet to be successful we cannot let the hydrogen grid grow into siloes or discrete operations.

There needs to be a national playbook, based on common, open interconnected solutions in much the same way that a contemporary Industry 4.0-compliant manufacturing plant is configured. A fully digitalised backbone, supported by powerful data and control solutions is essential.

The argument for digitalisation

We know that a successful hydrogen economy requires the creation of a complex infrastructure, its stability will be dependent on a strong digitalised system.

This will be critical for optimising these operations, the commercial context for companies involved and the economy as a whole.

As the International Energy Agency states, in order to hit net-zero by 2050, one of the most critical levers is optimising energy efficiency. Being able to monitor, manage and optimise how energy is used in hydrogen production and distribution, using tools like smart sensors, connected systems to monitor, control and optimise using a variety of edge and cloud technology, will enable us to minimise carbon emissions.

There is no alternative to achieving this than through digitalisation.

Taking this a step further, digitalisation is also fundamental to the economic manufacturing of the things that are required to fuel this economy, for example: electrolysers. Even the processes required to create them can be optimised, this can include the use of robotics and making operations as autonomous as possible.

Put simply, energy efficiency and digitalisation go hand-in-hand throughout the whole value chain needed in our new energy future.

Harnessing digital

Digital control solutions already exist to manage and optimise new energy sources and decentralised utility grid structures. For example: ABB's Ability OPTIMAX is designed to support the bi-directional flow of energy and information, by aggregating and optimising the energy resources, which can be spread over a wide geographical area, into a virtual power plant.

The rationale behind its development is to promote grid stability by simplifying operations, reducing energy costs and cutting emissions.

By aggregating data and giving clear, unambiguous insights into energy generation and use, information can then be used to optimise energy use and highlight efficiencies alongside ways to save costs.

Start small and scale

Like the Industry 4.0 manufacturing plant example, many pilot projects start small, maybe in one corner of the factory, and then scale. And, to a certain degree, this is what is happening in the UK.

Projects such as the East Coast Cluster and Hynet in the north-west are already demonstrating the potential of micro-hydrogen economies, which are combining generation, transportation, fuel use and CCUS on a local scale in a truly interconnected, interdependent value chain we've not seen before.

Although not governed by formal infrastructure standardisation, the clusters are growing up in a digital age and already have the opportunity to exploit digital connectivity which, among operational advantages, is also delivering the ability to exploit significant efficiency savings and gains. This has to be built into the blueprint of these projects now.

To create an entirely new hydrogen economy we have to grow it, nurture it and establish it as a norm before it gains wider acceptance and starts to garner the demand levels that will begin to impact climate targets. But we must act fast.

Scaling, so often the pain point in capital projects, is far simpler when today's digital solutions are incorporated in a capital phase as they remove many of the hurdles during operation by decreasing the complexity, thanks to flexibility and inherent agility of a digital infrastructure.

Creating a hydrogen economy

Once tighter digitalised controls and management are in place and the hydrogen market begins to even out, less volatile unit costs begin to manifest which ultimately make the market a far more attractive proposition for investors, as has been seen in the wind market.

Once these market forces begin to take over, funding will flow from sources other than local and central government and the industry will begin to sustain itself with easily identifiable value chains.

Digitalisation has proven its worth tenfold over the course of the last few years, with highly effective remote connectivity being the new normal upon which many current business models are based.

Task any engineer – electrical, mechanical or civil – with developing a clean-slate approach to modern infrastructure and you can guarantee that digital technologies will form a major part of the mix.

Unlike existing plants and operations, where they must digitally transform incumbent infrastructures, with hydrogen we can start with an interconnected digital foundation from which to expand outwards, upwards and onwards for a carbon-neutral future.