Hydrogen East

# H2 News Hub

## Issue 4

March 2021

## Top stories

In Issue 4 of **Hydrogen East**'s Sector Review, we take a look at important publications and developments over the month of February (2021).

Hydrogen East announced the a new research study to explore the potential for hydrogen production off the coast of East Anglia - the **Bacton Energy Hub: Exploring the potential for hydrogen from the Southern North Sea**.

The **Hydrogen Council** published a report, highlighting hydrogen's gathering momentum as projects accelerate, revealing that there are 228 large-scale projects that have been announced along the value chain, with the potential to see investments clear $300bn in spending through to 2030 if all come to fruition.

**Cadent** announced the UK's first hydrogen fuelled homes will be set to open to the public in April 2021, while the **Freeport East Hydrogen Hub** could contribute to six of the elements of the Prime Minister's 10-point plan for a Green Industrial Revolution.

The UK's nuclear industry declared its hydrogen ambitions with the **Nuclear Industry Council** unveiling a hydrogen roadmap,

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## Upcoming webinars

**2 March** – **UKERC**: Hydrogen Blending Standards Development in the UK, Canada and the US | **2-4 March** – **HSE**: Safety Excellence in Energy Series: Net Zero 2021 – Hydrogen | **3 March** – **UKHFCA**: The Case for Green Hydrogen | **4 March** – **Hydrogen Europe**: ALICE Collaboration Launch | **9 March** – **IRENA**: Green hydrogen – A guide to policy making | **11 March** – **Policy Exchange**: The Future of the North Sea | **17 March** – **Arup:** The future of ports and hydrogen | **24-25 March** – **Innovate East**: Hydrogen-based solutions sprint

## New study on hydrogen potential off Norfolk's coast

A new research study has been officially kicked off to explore the potential for hydrogen production off the coast of East Anglia.

The study, led by Hydrogen East, was announced on 22 February and will research options and scenarios to bring together the region's offshore gas and offshore wind sectors to produce clean hydrogen at scale for cleaner power, heat and transport fuels supplying the region and beyond.

The *Bacton Energy Hub: Exploring the potential for hydrogen from the Southern North Sea* study will provide a detailed map of existing offshore and onshore energy-related infrastructure and develop options and scenarios for where wind farms, gas platforms, subsea pipelines and cables could be integrated or repurposed over time to support hydrogen production, with the Bacton terminal on North Norfolk's coast being used for injection into the national grid.

**Figure 1: The Bacton Terminal on the North Norfolk Coast**

(Photographer: Mike Page)

The project is well timed following recent announcements such as the Prime Minister's Ten-Point-Plan for a Green Industrial Revolution, together with a wide range of independent research reports across the world, identifying a clear role for hydrogen to support the decarbonisation of heat and transport systems. The UK Government is due to publish a UK Hydrogen Strategy later this year which this regional study will help to inform.

Recent regional announcements are also highlighting a significant role for hydrogen such as plans for a hydrogen hub as part of the Freeports East bid led by the ports of Felixstowe and Harwich, supported by EDF Energy, Sizewell C, Ryse Hydrogen, JCB, New Anglia and South East Local Enterprise Partnerships, and many other partners including Hydrogen East.

Hydrogen and its use in the energy sector has developed rapidly over the past 18 months, internationally and in the UK, as a versatile gas and an essential enabler of meeting the UK's 2050 Net Zero target.

Hydrogen can be used and stored as a zero-carbon fuel supporting low-carbon heating for homes and business, and almost all forms of transport, from passenger cars to trains, heavy goods and farm vehicles, buses, trains, boats, and planes.

There is a growing level of research on how different technologies to produce hydrogen could be developed and scaled-up, such as electrolysers powered by offshore wind, nuclear, or solar; or reforming natural gas to hydrogen whilst capturing and storing carbon dioxide in depleted gas reservoirs under the North Sea.

The study is being co-funded by OGTC, the Offshore Renewable Energy Catapult, New Anglia Local Enterprise Partnership, and North Norfolk District Council, with support from New Anglia Energy, Opergy, and Xodus Group.

Nigel Cornwall, co-founder of Hydrogen East and a Director at New Anglia Energy, said: "Developing the options for a potential Bacton Energy Hub will help to facilitate and accelerate the transition towards net zero emissions. It is a key regional project, which could realise extensive potential benefits both in terms of supporting delivery of the Local Industrial Strategy and the stated aim of enabling Norfolk and Suffolk to become the UK's Clean Growth Region. It will contribute to Hydrogen East's driving objective of Norfolk and Suffolk becoming a significant regional hydrogen economy."

Martyn Tulloch, Head of Energy System Integration at OGTC, said: "This study will help to identify a pathway for enabling the transition from natural gas to clean hydrogen production across the Southern North Sea, with potential for carbon capture and storage. As the UK's principal gas basin, and with a significant portfolio of offshore wind projects, the region offers a real opportunity to explore a more integrated approach, with prospects to consider repurposing offshore pipeline infrastructure and the role of the Bacton terminal as an energy hub.

Andy Holyland, Regional Innovation Manager at OREC, said: "East Anglia has been leading the UK in the growth of offshore renewable energy and is well placed to expand on this under the UK's commitment to 40GW of offshore wind by 2030. It is vital that the region considers hydrogen in this expansion as a vital component to meeting regional and national net zero ambitions."

Cllr Richard Kershaw, Cabinet member for sustainable growth at North Norfolk District Council, said: "The Bacton feasibility study is a great initiative looking at the ways in which we can work together with partners to drive the clean energy agenda forward in North Norfolk. The Bacton terminal is a nationally significant asset and key employer for more than 50 years. New technologies such as hydrogen have the potential to create more jobs in North Norfolk, and to put us at the forefront of this fresh wave of green energy production for the next 50 years."

This scoping study is the first phase of a potential three-part project, comprising:

1. scoping, indicative market assessment, and initial feasibility and options study
2. options development, detailed project definition, and concept engineering studies
3. establishment of demonstration project(s) with funding and partnering arrangements, supported by a detailed net zero-based engineering pathway for the Bacton Energy Hub.

A virtual event will be held on 8th April 2021 to update stakeholders on project progress, and ongoing work of other Hydrogen East workstreams.

Visit https://hydrogeneast.uk or email mail@hydrogeneast.uk for more information.

**Freeport East Hydrogen Hub will boost decarbonisation agenda**

A hydrogen hub, centred on the Port of Felixstowe and Harwich International Port, has the potential to be one of the world's most "exciting and innovative" nuclear, hydrogen, maritime and transport decarbonisation schemes, according to those behind it.

At its peak, the Freeport East Hydrogen hub would produce 1GW of hydrogen, 20% of the target set out in the Prime Minister's 10-point plan for a Green Industrial Revolution. It will be delivered in partnership with Ryse-Hydrogen and EDF, creating a significant number of new jobs within the next 12 months – up to 13,500 – as well as generating investment of over £500mn and providing a £5.5bn economic boost over 10 years.

Other partners include South East and New Anglia LEPs, Suffolk and Essex county councils, Mid Suffolk Council, East Suffolk Council, Tendring District Council, Harwich Haven Authority and the Harwich Gateway Partnership. It also has the backing of a number of businesses, business organisations and education providers.

Jo Bamford, Executive Chairman of Ryse-Hydrogen, said the hub has the potential to rival some of the world's biggest "green projects" and that delivery is achievable within 18 months due to the significant private organisations involved.

**UK set for first homes fuelled entirely by hydrogen**

The UK's first homes with household appliances fuelled entirely by hydrogen are set to open in April 2021.

On 16 February, Cadent revealed that the homes, which it has funded alongside Northern Gas Networks (NGN) and the Hy4Heat Innovation programme, will show how hydrogen has the potential to act as a clean replacement for natural gas in the home. The homes will use 100% hydrogen for domestic heating and cooking in appliances such as boilers, hobs, cookers and fires, producing no carbon at point of use with the only by-product water.

The project secured a £250,000 grant from Hy4Heat and will be run by Cadent and NGN, both of which have contributed £250,000 each. The homes will be located in Low Thornley, Gateshead, and are planned to be open to the public, ensuring they can see the appliances, how they work and how they compare to existing ones.

Local schools, colleges and universities will be invited to learn more about the technology and potential careers in the emerging green economy and science, technology, engineering and maths subjects.

The hydrogen homes are expected to have a three-year lifespan but could go for longer, as much as 10 years. They are not intended to be habitual, instead they will simply showcase the use of hydrogen fuelled applications in a real-world domestic setting.

**IEA hydrogen eyes expansion of activities with new projects**

The International Energy Agency (IEA)'s Hydrogen technology collaboration is proposing a major expansion of its activities through six projects.

On 8 February, IEA Hydrogen, which seeks to offer opportunities to work with international experts on hydrogen topics, set out plans for projects including renewable hydrogen production; hydrogen applications in the mining, resources and mineral processing sectors; and hydrogen from nuclear energy. It is also proposing to explore hydrogen production in wind farms, hydrogen's expert value chains and underground hydrogen storage.

Interested parties should contact the UK's Alternate Delegate to IEA Hydrogen, Professor Paul Dodds of University College London, and complete the National Team Survey.

**Ricardo looks to transform south coast with Hydrogen Sussex**

Ricardo is targeting a transformation of the south coast into a national hub for green transport and energy.

On 26 February, Ricardo announced the launch of Hydrogen Sussex, which has seen it join forces with local authorities and partners from academia, industry, transport and utilities. The goal is to pool expertise to position hydrogen as a mainstream energy carrier to help the drive towards a zero carbon economy, supporting and stimulating the development of zero emissions solutions for the aviation, marine and heavy duty commercial vehicle sectors – all of which are considered critical to the UK economy.

Steve Dyke, MD of Ricardo Automotive and Industrial, set out how they are investing £2.5mn in a hydrogen development and test facility at their Shoreham Technical Centre in West Sussex, with the plan to then grow a "globally recognised centre of excellence for hydrogen, defossilised fuels and electrified transport engineering in the south east of the UK."

Dyke added: "It will be at the heart of a local hydrogen eco-system consisting of technology development, supply and use of hydrogen. Through Hydrogen Sussex, we want to bring together industrial partners, local universities, utility companies, transport operators, and policy makers and draw on their capabilities as part of a unique collaborative hub."

**Experts explore hydrogen deployment in the UK**

Hydrogen is no longer something a long way in the future, making the need to capitalise on research and development all the more pressing, according to Tim Harwood of Northern Gas Networks (NGN).

On 23 February, Harwood was among the speakers at the Hydrogen Summit, held by PRASEG – the All Party Parliamentary Group for Renewable and Sustainable Energy – and the Energy Networks Association (ENA), which saw industry experts discuss hydrogen deployment and its potential benefits to the UK. Drawing on the work being undertaken by NGN, Harwood stressed the importance of starting with tangible things people are able to look at, feel and touch when it comes to deployment of hydrogen. When quizzed on how to defeat scepticism, Harwood explained that is why NGN has been involved with building hydrogen houses in Low Thornley and doing trials in closed communities. By taking hydrogen into the public domain, it shows that it is something that has come to life, is tangible and no longer just a vision.

Angela Needle of Cadent, meanwhile, drew on the community benefits of hydrogen, citing Cadent's role in the HyNet consortium as an example. It is not just about meeting net zero, Needle said, but creating jobs and wealth locally – something hydrogen would allow for. Ensuring the network is able to receive hydrogen requires investment to ensure the mains replacement programme continues its work, bringing more skilled engineers into the region and retaining, as well as reskilling, existing gas engineers.

Dr Fiona Fylan of Leeds Becket University, meanwhile, outlined some of the key findings from the extensive research she has done with her team on hydrogen, both on a national and regional level. Nationally, they found overwhelming support for conversion of heating to hydrogen once customers are aware of the impact gas has on climate change.

A similar picture was found at a regional level in Yorkshire and the Humber, which explored hydrogen for domestic fuel and transport. As well as the benefits when it comes to emissions and air pollution, the research also revealed that residents feel a hydrogen economy in Yorkshire and the Humber would make it a better place to live. It would attract jobs, notably higher paid jobs, to the area which would boost the economy, benefit the supply chain and also attract sustainable businesses, as well as sustainable people to the region.

## Hydrogen gathering strong momentum as projects accelerate

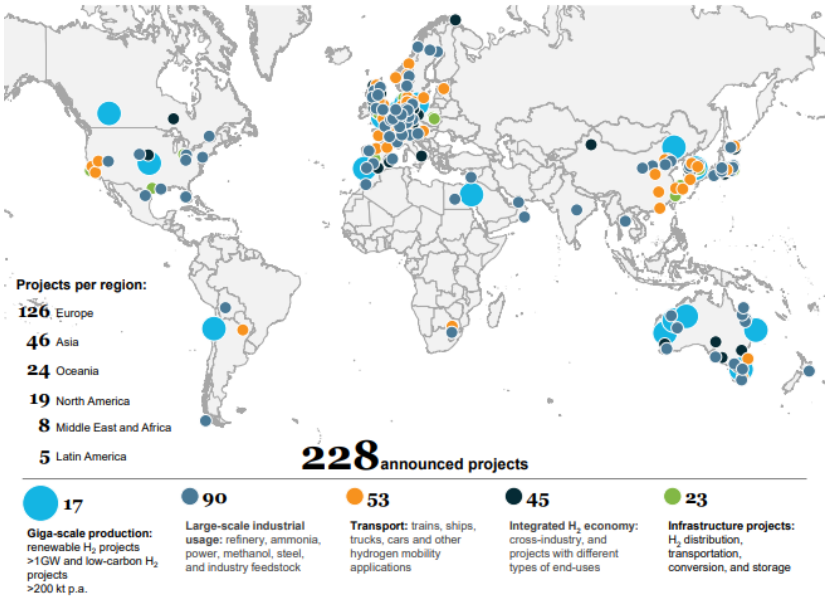
Hydrogen has been tipped to become the most competitive low carbon solution in more than 20 applications by 2030, including long haul trucking, shipping and steel.

On 17 February, the Hydrogen Council published a report, highlighting how there has been a rapid acceleration of hydrogen projects. Over 30 countries have released hydrogen roadmaps as of early 2021, with governments worldwide committing public funding to hydrogen technologies and 228 large-scale projects announced along the value chain, 85% of which are in Europe, Asia and Australia. If all of these, which include large-scale industrial usage and transport applications, come to fruition, they would see investments exceed $300bn in spending through to 2030. Of this, $80bn can be considered mature, meaning these projects are in the planning stage, passed a final investment decision, are under construction, already commissioned or operational.

On a company level, meanwhile, Hydrogen Council members – which include the likes of Hyundai, EDF, Microsoft, Shell, BMW Group and Audi - are planning a sixfold increase in their own total hydrogen investments through to 2025, with a 16-fold increase targeted through 2030. The plan is for most of this investment to be directed towards capital expenditures, followed by merger and acquisitions and R&D activities.

**Figure 2: Global hydrogen projects across the value chain**

(Source: Hydrogen Council)



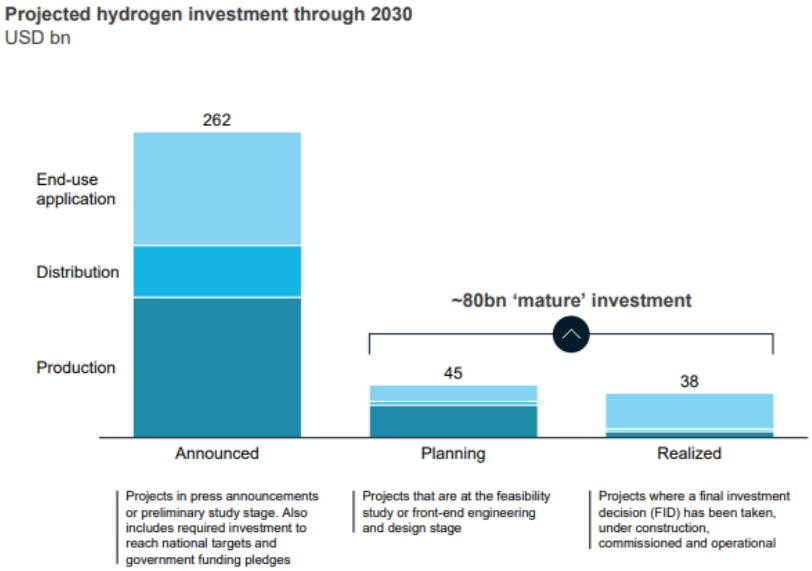

Drawing on how hydrogen can become the most competitive low carbon solution in more than 20 applications, the report set out two key factors, the first being that governments must sustain their commitments to deep decarbonisation, backed by financial support, regulation and clear hydrogen strategies and targets.

These would then be translated into long-term regulatory frameworks. It noted that renewable hydrogen production costs can be driven down faster than expected, if scaled up with these regulatory frameworks and public support, along with a continued decline in renewable costs alongside a rapid scale-up of value chains for electrolysis and carbon management as well. This could see renewable hydrogen costs decline to $1.4 to $2.3/kg by 2030, with low carbon

hydrogen potentially breaking even with grey hydrogen between 2028 and 2034 at a cost of around $35-50 per ton of carbon dioxide equivalent.

**Figure 3: Breakdown of announced investments by maturity**

(Source: Hydrogen Council)




Secondly, deployment approaches must look to target key unlocks, such as reducing the cost of hydrogen production and distribution, as this will have the most substantial impact on the rest of the industry. A cost-efficient transmission and distribution to unlock hydrogen applications is key with a network of pipelines the best way to achieve this over the longer term, while co-locating hydrogen production either on or near sites that connect resource-rich regions to demand centres is the most competitive set-up in the short-term.

Longer distances can be covered by shipping, it continued, where hydrogen needs to be converted to increase its density. While there are hydrogen carrier approaches that exist, three carbon neutral carriers – liquid hydrogen, liquid-organic compounds and ammonia – are the ones gaining the most traction. In terms of determining the most cost optimal solution, the end use of hydrogen needs to be considered.

While hydrogen has the potential to be the most competitive low-carbon solution in more than 20 applications by 2030 from a total cost of ownership (TCO) perspective, this will not be the only driver of adoption. Customers and investors' decisions will be influenced by future environmental regulations, ESG-compliant investments and associated green premiums. Hydrogen application is also advancing in aviation, while other end applications – such as buildings and power – will need a higher carbon cost to become cost competitive.

Deployment through clusters with strong off-takers can further help suppliers when it comes to sharing investments as risks, as well as establishing positive reinforcing loops. The main cluster types gaining traction are industrial clusters, supporting refining, power generation and fertiliser and steel production; export hubs in resource-rich countries; and port areas for fuel bunkering, port logistics and transportation.

Reduced costs stemming from these clusters will be key in enabling global trade in hydrogen, connecting future demand centres such as Japan, South Korea and the EU to areas with abundant low-cost hydrogen production means, including the Middle East, North Africa, South America and Australia.

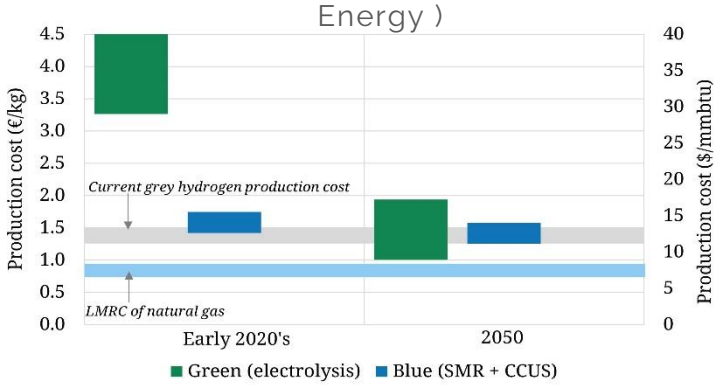
## Timera Energy explores factors driving hydrogen investment

Timera Energy has explored factors likely to drive hydrogen investment, supply chain value and impact on existing energy portfolios.

On 1 February, it set out how after hydrogen gathered momentum in 2020, defining policy support and business models that drive rapid investment in hydrogen supply chains is the key challenge in 2021. Although headline policy announcements have so far targeted green hydrogen, Timera warned targeting electrolysers alone will result in a slower pace and scale of hydrogen deployment. Incremental demand drive by the EU and UK electrolyser targets announced to date, which is around 45GW, will see European power demand increased by 5% by 2030 though the volume of green hydrogen produced will still be "well short" of what is needed to progress decarbonisation of the hardest to electrify areas.

It acknowledged a broader focus is emerging, with both the EU and UK recognising a need for blue hydrogen, indicating leaders are pragmatic about scaling hydrogen at speed, before exploring the potential factors that could shape how this would happen in practice.

**Figure 4: Green and blue hydrogen cost ranges versus current alternatives** (Source: Timera Energy )




Cost is a factor, with hydrogen expensive whether produced from electricity or natural gas. These high production costs mean initial deployment will likely focus on high value end users in industrial clusters. Supply chain costs, meanwhile, are likely to shape competitiveness with blue and green hydrogen having very different supply chain structures. Long-term, from 2040 and beyond, incremental investment in hydrogen production capacity will likely be dominated by green hydrogen but across the next 20 years, with limits to how fast electrolysers can be scaled, there is a way for green and blue hydrogen to both compete and co-exist.

Hydrogen could evolve into a more liquid market over time, the next 10 years at least will see end user requirements play a key role in shaping hydrogen deployment and supply chains. Local hydrogen markets will likely develop faster than cross border markets.

Elsewhere, hydrogen being cheaper to store than power could be an important factor in shaping supply chains and utilisation. Electrolysers are also capable of providing key flexibility services to power networks to compliment electricity storage. The subsequent revenue from these services will form an important part of the investment case for green hydrogen projects. The final factor is policy, which should focus on scaling, rather than picking winners. Policy makers currently focused on defining hydrogen support mechanisms to incentivise competition and drive down costs; support rapid scaling; allow access to low cost financing; facilitate a level playing field; and do not impose an unreasonable cost burden on consumers.

It further noted that the EU and national governments have learnt key lessons from renewables deployment that will shape their approach to hydrogen and likely support a much faster evolution of support mechanisms. The details of national support mechanisms expected to emerge over 2021 to 2022 will prove a key catalyst for scaling investment in hydrogen infrastructure.

### AI green hydrogen technology set to be trialled

H2GO Power has joined forces with the European Marine Energy Centre (EMEC) and Imperial College London to trial artificial intelligence software with hydrogen technology.

On 10 February, EMEC outlined how the HyAI project is a pilot demonstration of AI software-controlled hydrogen storage technology with the aim of showing how this integration can lead to intelligent, data-driven asset management decisions in real time, optimising renewable energy integration into the grid. The project is underway and will remain live until summer 2021, with initial results already showing the AI-enabled approach can produce hydrogen more cost effectively and alleviate stresses on the grid.

AI software has been integrated with one of H2GO Power's hydrogen storage units, while EMEC has supplied energy data from its Hydrogen Production Plant in Orkney. The AI platform acts as an energy management system, integrating data about the weather, electricity prices and grid management, with this then translated using its predictive algorithms to optimise the operation of the storage units by predicting both future power costs and user demands.

In future, the goal is for there to be a commercial demonstration of H2GO's AI software platform and power to power hydrogen storage technology. EMEC revealed it has signed a memorandum of understanding with H2GO to install and integrate the technology at its test site in Orkney.

### Hydrogen waste heat research targets reduced emissions and cost savings

A world-first research project is aiming to develop a new way of recovering waste heat from industry and decarbonise heating and cooling through hydrogen technologies.

On 2 February, London South Bank University (LSBU) set out how the project will investigate new ways of providing heating and cooling from energy intensive industries, such as steel, glass, paper and food. The hydrogen technologies to be studied will include chemical heat pumps to recover waste heat at various grades, long-distance transport networks capable of transferring recovered energy more efficiently, and advanced heating and cooling systems.

Using hydrogen technology to recover waste can deliver substantial cost and energy savings, according to LSBU. Around 60% of total waste heat produced in the UK by industry is potentially reusable in district networks, while use of the hydrogen technology will bring significant carbon emissions reductions anyway. The higher energy and cost savings than renewable energy are due to lower cost from limited heat recovery facilities and larger temperature ranges, stretching from 40˚C to 1650˚C. The project will run for three years and has been granted £979,290 in funding from the Engineering and Physical Sciences Research Council.

### Coalition eyes 100% green hydrogen at €1.5/kg by 2030

A group of 30 European energy players have launched the HyDeal Ambition, aiming to deliver 100% green hydrogen across Europe at €1.5/kg before 2030.

Under the HyDeal Ambition, unveiled on 11 February, the production of green hydrogen will be generated by solar-driven electrolysis from the Iberian Peninsula from 2022. The goal is to achieve 95GW of solar and 67GW of electrolysis capacity by 2030, delivering 3.6mn tonnes of green hydrogen per year in the energy, industry and mobility sectors through the gas transmission and storage network. It will proceed via a phased approach, with first deliveries to take place in Spain and the Southwest of France.

Projects and partnerships are currently being launched involving several of the participants, which include DH2/Dhamma Energy, Falck Renewables and McPhy Energy. A first initiative is expected within a year in Spain, based on a portfolio of solar sites that have a capacity of close to 10GW.

**C-Zero looks to produce clean hydrogen from natural gas**

C-Zero is aiming to "bridge the gap" between existing natural gas infrastructure and a low carbon future after raising $11.5mn (£8.25mn).

On 9 February, it announced the results of a Series A funding round, co-led by Breakthrough Energy Ventures and Eni Next, with participation from Mitsubishi Heavy Industries (MHI) and AP Ventures. It will now use the funds to move from lab tests to its first pilot-scale production facility for its drop-in decarbonisation technology, allowing industrial natural gas consumers to avoid producing CO2 in applications such as electrical generation, process heating and the production of commodity chemicals.

Initially developed at the University of California, the technology uses thermocatalysis to split methane into hydrogen and solid carbon in a process called methane pyrolysis. The hydrogen being produced from this process is increasingly being referred to as turquoise hydrogen, it noted, which combines the benefits of both blue and green hydrogen owed to being low cost and low emissions.

The hydrogen can then be used to decarbonise a range of existing applications, including hydrogen production for fuel cell vehicles, with the carbon permanently sequestered. Furthermore, if renewable natural gas is used as feedstock, then C-Zero said its technology can be carbon negative.

**Consultants appointed to deliver a hydrogen investment strategy for Thames Estuary**

Ikigai, supported by DNV GL, has been appointed to deliver a hydrogen investment strategy for the Thames Estuary.

On 3 February, Ikigai, reflecting back to a virtual summit in November 2020, noted significant interest in the development of a hydrogen ecosystem in the Thames Estuary. The anticipated demand sparked by a shift away from fossil fuels, as well as the location of the Estuary and its capacity to deliver at scale make it an "extremely compelling case" for investors, it added.

Ikigai and DNV GL will now create a roadmap to realise this opportunity. It will evaluate and identify the potential for investable hydrogen generation, distribution, storage and usage infrastructure within the Estuary, seeking to meet the commitments set out in the action plan released at the time of the summit, The Green Blue. These include driving green growth and spearheading the development of a hydrogen ecosystem that allows for the greening of transport on land and water, along with accelerating decarbonisation.

**Acciona launches platform to guarantee renewable origin of green hydrogen**

Acciona has developed the world's first platform based on blockchain technology that guarantees the renewable origin of green hydrogen.

On 2 February, the Spanish firm announced the launch of *GreenH2chain*, which allows clients to verify the transportation and delivery process of green hydrogen. Customers are granted access to a digital platform, enabling them to see the entire green hydrogen value chain in real time from anywhere in the world

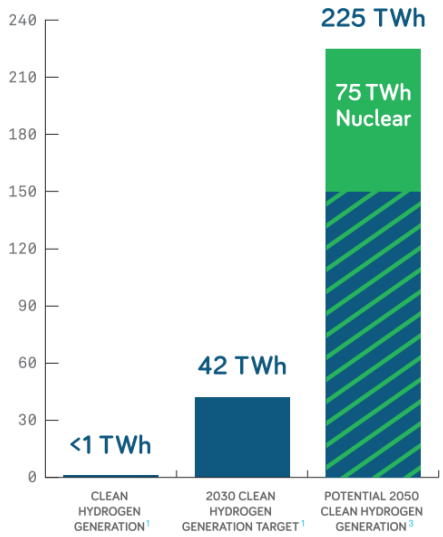
The solution offers all of the necessary information on hydrogen consumption, as well as the CO2 emissions consumers can save by using it, meaning they are able to quantify, record and monitor the decarbonisation process of their own energy supply. *GreenH2chain* will be complementary to any official systems that emerge in future dedicated to certifying the renewable origin of hydrogen, offering its differential values to them, both at a European level and in each individual country.

## UK nuclear industry unveils hydrogen roadmap

Nuclear power could produce a third of the UK's clean hydrogen needs by 2050, according to a roadmap unveiled by the Nuclear Industry Council (NIC).

On 18 February, the NIC outlined how large-scale and small modular reactors (SMRs) can generate the necessary power and heat to produce green hydrogen. With nuclear stations able to provide a constant, reliable supply of power, electrolysers can operate more efficiently, cutting production costs. Large-scale reactors can produce green hydrogen today at scale through electrolysis, as could next generation gigawatt-scale reactors, while SMRs can unlock further possibilities for green hydrogen production near industrial clusters.

**Figure 5: Clean hydrogen production** (Source: NIC)




It further drew on advanced modular reactors (AMRs) under development, noting they offer one of the most promising innovations for green hydrogen production. This is because they will create temperatures high enough to split water without diverting electricity. This ability to generate both power and hydrogen would cut costs further, add flexibility and allow co-location of reactors with industry, further aiding decarbonisation.

The Committee on Climate Change has estimated the UK will have to generate four times as much clean power by 2050, as well as 225TWh of low carbon hydrogen to enable decarbonisation. Nuclear can be a key part of the clean hydrogen mix, with the roadmap setting an ambition to produce 75TWh of hydrogen by 2050, with around 12-13GW of dedicated nuclear capacity capable of producing this.

However, to develop green hydrogen capabilities for all types of nuclear reactors, policy and regulatory issues must be overcome with cost identified as the main barrier.

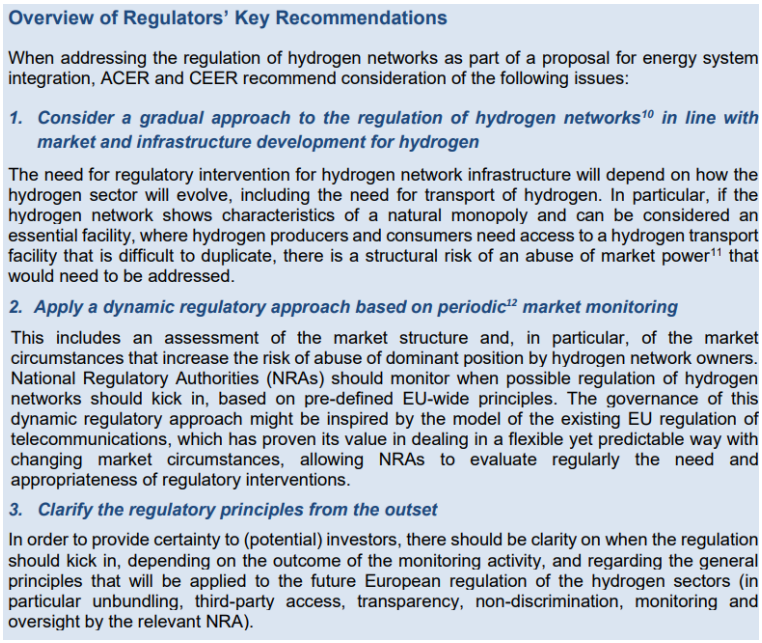
In a bid to rectify this, it recommended a grant and subsidy scheme is set up to encourage research and development to help reduce the costs of electrolysers; a new funding model to reduce the cost of capital associated with nuclear projects, cutting the price of the electricity they produce; and for government and Ofgem to collaborate, exploring the scope for a new scheme to gradually replace payments to zero carbon generators for constraining generation with support for hydrogen production.

It also called for an ambitious carbon pricing system that reflects the full externalities of emissions and the UK's net zero target; ensuring nuclear-produced hydrogen does qualify for Renewable Transport Fuel Obligation (RTFO) support; ensuring that nuclear-hydrogen production in a range of forms is eligible for inclusion in the recently announced Net Zero Hydrogen Production fund; and that an AMR development timeline is set out, including a demonstration of hydrogen production technology, involving five-year R&D funding settlements to provide stability.

# Paper explores regulating hydrogen networks of the future

There should be a gradual approach to regulating hydrogen networks in Europe, with interventions dependent on how the sector evolves, Europe's energy regulators have said.

**Figure 6: Some of the regulators' key recommendations** (Source: ACER & CEER)



**Overview of Regulators' Key Recommendations**

When addressing the regulation of hydrogen networks as part of a proposal for energy system integration, ACER and CEER recommend consideration of the following issues:

1. ***Consider a gradual approach to the regulation of hydrogen networks[10] in line with market and infrastructure development for hydrogen***

The need for regulatory intervention for hydrogen network infrastructure will depend on how the hydrogen sector will evolve, including the need for transport of hydrogen. In particular, if the hydrogen network shows characteristics of a natural monopoly and can be considered an essential facility, where hydrogen producers and consumers need access to a hydrogen transport facility that is difficult to duplicate, there is a structural risk of an abuse of market power[11] that would need to be addressed.

2. ***Apply a dynamic regulatory approach based on periodic[12] market monitoring***

This includes an assessment of the market structure and, in particular, of the market circumstances that increase the risk of abuse of dominant position by hydrogen network owners. National Regulatory Authorities (NRAs) should monitor when possible regulation of hydrogen networks should kick in, based on pre-defined EU-wide principles. The governance of this dynamic regulatory approach might be inspired by the model of the existing EU regulation of telecommunications, which has proven its value in dealing in a flexible yet predictable way with changing market circumstances, allowing NRAs to evaluate regularly the need and appropriateness of regulatory interventions.

3. ***Clarify the regulatory principles from the outset***

In order to provide certainty to (potential) investors, there should be clarity on when the regulation should kick in, depending on the outcome of the monitoring activity, and regarding the general principles that will be applied to the future European regulation of the hydrogen sectors (in particular unbundling, third-party access, transparency, non-discrimination, monitoring and oversight by the relevant NRA).

On 9 February, the Council of European Energy Regulators (CEER) published a white paper focused on when and how to regulate the hydrogen networks of the future. Specifically, it sought to explore circumstances under which regulation is needed, how existing hydrogen infrastructure should be treated, and how to address regulatory challenges related to the repurposing of gas infrastructure for dedicated hydrogen transport.

Unlike when regulation was brought in for gas and electricity networks, hydrogen infrastructure is not in place in most member states. The market also still needs to be developed. The availability of infrastructure for connecting supply and demand was cited as a condition for widespread use of hydrogen as an energy carrier in the EU in the EU's Hydrogen Strategy, with the paper noting the future development of this is where the potential need for regulation would stem from.

Together with the Agency for the Cooperation of Energy Regulators (ACER), CEER set out several issues in need of consideration when addressing the regulation of hydrogen networks as part of a proposal for energy system integration.

As well as the need for a gradual approach, it called for a dynamic regulatory approach to be taken as well, based on periodic market monitoring. This would include an assessment of the market structure and circumstances that would increase the risk of abuse of a dominant position by hydrogen networks. It also called for regulatory principles to be clarified from the outset, providing certainty to investors as to when regulation should kick in and regarding the general principles that will be applied to future European regulation of the hydrogen sectors.

The regulatory framework should be clarified from the outset for private hydrogen networks constructed as business-to-business networks as well. There is a need to foresee temporary exemptions to future regulation, which may be explicitly foreseen in forthcoming EU legal framework, avoiding that point-to-point pipelines are unnecessarily impacted while ensuring those exemptions are given under the same EU regulatory framework.

Consideration of the benefits of repurposing gas assets for hydrogen transport was also recommended, for both gas and hydrogen end users. This would be assessed on a case-by-case basis through cost benefit analyses, taking all relevant factors into account. Elsewhere, cost reflectivity should be applied to avoid cross-subsidisation between the gas and hydrogen networks.

**EU unveils plans for hydrogen partnership**

The EU is planning to accelerate the development and deployment of a European value chain for clean hydrogen technologies through a new partnership.

On 23 February, the European Commission unveiled plans to launch a series of new partnerships between the EU, Member States and industry, investing close to €10bn for the green and digital transition. Aims of these partnerships include improving EU preparedness and response to infectious diseases, developing efficient low carbon aircraft for clean aviation, supporting the use of renewable biological raw materials in energy production, and ensuring European leadership in digital technologies and infrastructure. The Clean Hydrogen partnership will focus on producing, distributing and storing clean hydrogen, as well as supplying sectors that are hard to decarbonise, including heavy industries and heavy-duty transport applications.

Working alongside the Hydrogen Alliance, it will aim to help achieve the objectives set out within the EU's hydrogen strategy for a climate-neutral Europe. The strategy outlined a phased approach for a gradual transition, beginning with the installation of at least 6GW of renewable hydrogen electrolysers in the EU from 2020 to 2024, before eventually seeing renewable hydrogen technologies reach maturity and be deployed at large scale across all hard-to-decarbonise sectors between 2030 and 2050.

**Project to examine potential of liquid organic hydrogen carriers**

A collaborative study will explore the potential of using liquid organic hydrogen carriers (LOHC) for the mass transportation of hydrogen around the UK and Europe.

On 11 February, the Oil and Gas Technology Centre (OGTC), when announcing the first details, said the project will mark an important step in advancing knowledge of the hydrogen transportation and storage technologies required to enable the development of a Scottish hydrogen economy. The OGTC is working in collaboration with the Scottish government, Global Energy Group, Pale Blue Dot, Port of Cromarty Firth, Environmental Resources Management (ERM) and the Shetland Islands Council.

The first phase will be conducted by ERM, evaluating the techno-economical, safety and environmental benefits of LOHC for marine transportation. The project will also examine the suitability of existing conventional oil and gas assets and ports, as well as gathering evidence to assess the technical and economic feasibility of repurposing existing marine assets for LOHC transportation. Environmental assessments will be carried out where various mass transportation solutions are compared to determine further phases of the study.

**Element Two plots rollout of hydrogen pumps**

Element Two is aiming to deploy more than 800 hydrogen pumps across the UK by 2027.

On 10 February, H2 View reported that Element Two is investing in "prime locations" in the North of England, Scotland and Ireland, with a future target of 2,000 hydrogen pups by 2030 in its sights. Such a move would mark a "massive breakthrough" for the UK's hydrogen mobility sector, it said, citing UK H2Mobility's refuelling station map which shows only 12 hydrogen stations currently open today in the UK and the fact that uptake of fuel cell electric vehicles has been slow.

Sir Vince Cable, who has joined Element Two as a non-executive director, said: "Production of hydrogen is a cornerstone of EU and UK energy policy and uptake of hydrogen fuelled vehicles is gathering momentum. It is essential that we have the right infrastructure in place to facilitate the needs of a hydrogen transport network and that aspirational and sustainable businesses such as Element Two have the right support to make this happen in terms of strategic guidance, investee and a broader brand awareness."

Hydrogen East

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# Upcoming events

**Net Zero East Launch – 14 April 2021**

**Bacton Energy Hub: Findings Dissemination – 4 May 2021**