Hydrogen East

H2 News Hub

Issue 6

May 2021

Top stories

In Issue 6 of **Hydrogen East**'s Sector Review, we take a look at important publications and developments over the month of April (2021).

The EHB Initiative presented an updated version of its vision for a dedicated hydrogen infrastructure across Europe, showing how a mature **European Hydrogen Backbone** can be created as soon as 2040. The report also highlights the role Bacton could play.

The **Energy Transitions Commission** published a report, exploring the complementary role that hydrogen will play in an electrified economy. It sets out how a combination of private-sector collaboration and policy support can drive the initial ramp up of clean hydrogen production and use to reach 50mn tonnes by 2030

The **Energy & Utilities Alliance** looked into the challenge of decarbonising heat in buildings and emphasised just how repurposed gas networks carrying hydrogen are set to be a crucial part of the journey to net zero. Heat pumps, while important, should be supported by a "mosaic of heating solutions" that include a hydrogen gas network.

Hydrogen Europe, meanwhile, made the case for a "**Hydrogen Act"** for Europe, stressing that hydrogen must become a central pillar of the energy system with a dedicated framework

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Upcoming webinars

11-12 May – **EIC:** The North Sea Decarbonisation Conference | **12 May** – **KTN:** Tees Valley Hydrogen Transport Hub Competition Briefing | **18 May** – **Muegee:** Carbon-negative Hydrogen Production | **20 May** – **Hydrogen East:** Bacton Energy Hub scoping report | **20-21 May** – **Reuters:** Hydrogen 2021: Digital Conference and Exhibiton | **25 May** – **NS HyMaP:** Large Green Hydrogen Projects in the North Sea Region

European Hydrogen Backbone could span 40,000km

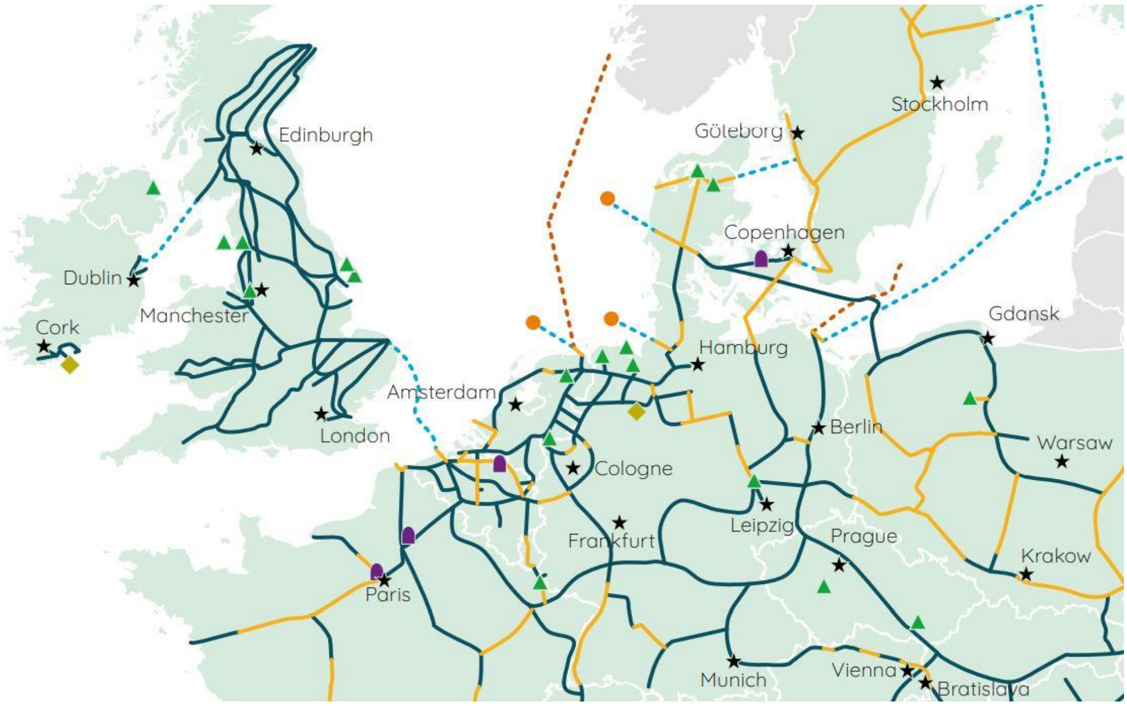
A further 12 European gas TSOs from 11 countries have joined the European Hydrogen Backbone (EHB) initiative, growing the size of the proposed network to almost 40,000km.

On 13 April, the EHB initiative presented an updated version of its vision for a dedicated hydrogen infrastructure across Europe, proposing a network of 39,700km by 2040, involving 23 gas infrastructure companies from 21 countries.

Those behind it believe it will create an opportunity to accelerate decarbonisation of the energy and industrial sectors, while also ensuring energy system reliance, increased energy independence and security of supply across the continent. It can be achieved in cost effective fashion, but this requires close collaboration between EU Member States and neighbouring countries, along with a "stable, supportive and adaptive regulatory framework".

Figure 1: A mature European Hydrogen Backbone can be created by 2040

(Source: EHB Initiative)



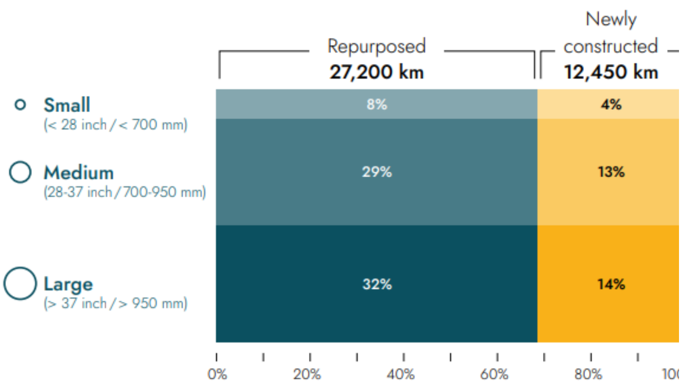
It marks a significant increase from the initial July 2020 report which described a 23,000km network, spanning across 10 countries. Around 69% of the proposed network would be repurposed existing natural gas grids, with the remaining 31% newly built pipelines to connect new off-takers.

The infrastructure will call for an estimated total investment of around €43-81bn. The investment per kilometre of pipeline was found to be lower than the previous report, owed to that research only including cost estimates for pipelines with a diameter of 48 inches. The new report takes into consideration the fact that a large part of the current natural gas infrastructure, as well as future hydrogen infrastructure, consists of smaller pipelines which are cheaper to repurpose.

Furthermore, it found that the EHB could prove a cost effective option for long distance transportation of hydrogen, highlighting how transportation over 1,000km would cost an average of €0.11-0.21/kg.

Figure 2: Breakdown of the European Hydrogen Backbone network by pipeline length, diameter, and share of repurposed vs new pipelines

(Source: EHB Initiative)



The EHB would develop from an initial 11,600km pipeline in 2030, which connects emerging hydrogen valleys, into a pan-European network by 2040 with further network development expected beyond this date.

It would also support integration of renewable and clean energy sources in regions that were not included within the previous report, such as Finland, Estonia, large parts of central and eastern Europe, Greece, Ireland and the UK. On the UK, in particular, the report set out how a dedicated hydrogen transmission system is expected to emerge through a phased repurposing of the existing natural gas transmission pipelines to join the country's largest industrial clusters in Grangemouth, Teesside, Humberside, Merseyside and South Wales.

By 2030, it is expected that at least four of the five industrial clusters will be connected, forming the basis of a hydrogen transmission backbone in the UK. There could be connections to St Fergus in Scotland and Bacton that would further provide additional hydrogen supplies capable of integrating large amounts of offshore wind energy.

All clusters could be connected by 2035 with a converted pipeline to Bacton potentially enabling future hydrogen flows across the interconnectors between GB and Belgium, and GB and the Netherlands, once ready. Further pipelines would likely start to emerge between 2035 and 2040, ahead of the hydrogen network expanding throughout the 2040s as production scales. This would allow for a greater reach across the industrial, power, transport and domestic heating sectors.

The EHB Initiative stressed that while the hydrogen infrastructure maps it sets out for 2030, 2035 and 2040 all reflect the vision of the 23 European gas TSOs involved – based on their analysis of how infrastructure could evolve to hit decarbonisation targets – none of the transportation routes and timelines are "set in stone".

Instead, the final design for a European Hydrogen Backbone, as well as a timeline, will depend on market conditions for hydrogen and natural gas, with the EHB Initiative reiterating the need once more for the creation of a "stable, supportive and adaptive regulatory framework" as a crucial enabling factor.

Professor Ad van Wijk, author of the 2x40GW Electrolyser Plan, as well as an advisor to Hydrogen Europe, said: "Europe needs to rapidly develop dedicated hydrogen pipeline infrastructure. This new EHB report shows a clear roadmap of how this could work."

Figure 3: Estimated investment and operating cost of the European Hydrogen Backbone (2040)

(Source: EHB Initiative)

		Low	Medium	High
Pipeline cost	€ billion	33	41	51
Compression cost	€ billion	10	15	30
Total investment cost	**€ billion**	**43**	**56**	**81**
OPEX (excluding electricity)	€ billion/year	0.8	1.1	1.8
Electricity costs	€ billion/year	0.9	1.1	2.0
Total OPEX	**€ billion/year**	**1.7**	**2.2**	**3.8**

Octopus Energy targets green hydrogen expansion

The Octopus Energy Group is set to expand into the green hydrogen sector later this year.

On 20 April, *Current News* reported that the plan is to bring a locally distributed "green hydrogen as a service" proposition to market as part of a new division of the company. Octopus Hydrogen will officially launch in Autumn 2021 with the green hydrogen to serve sectors including heavy goods transportation, energy storage, industrial applications and aviation. The group believes it can deliver benefits to "parts of the economy electrification can't reach".

According to the Octopus Hydrogen website, it is pledging an end-to-end solution which supplies hydrogen as a service. This will be 100% green hydrogen, delivered with options for on-site renewables, no capital expenditure required and payment per kilo. Other elements include flexible storage, with the ability to continue a normal operating model through Octopus' "innovative portable solution" and fuel-on demand, with it pledging to take care of storage, compression, cooling and dispatch, scaling supply when needed.

North Sea pipeline would transport 1mn tonnes of green hydrogen a year

Plans for a pipeline that could transport up to 1mn tonnes of green hydrogen annually are set to progress, after GASCADE, Gasunie, RWE and Shell signed a declaration of intent.

On 26 April, the companies announced their intention to further intensify collaboration on the AquaDuctus project, a pipeline that will transport green hydrogen from the North Sea directly to Europe. It is part of the AquaVentus initiative, which is aiming to install 10GW of electrolysis capacity for green hydrogen production between Heligoland and the Dogger sand bank. Through dovetailed sub-projects, demand, generation and transport of hydrogen will be synchronised, allowing for a "swift market ramp-up".

AquaDuctus is the vision for the first German offshore hydrogen pipeline and, once the generation plants are constructed, could transport as much as 1mn tonnes of green hydrogen a year from 2035 onwards. This would make a significant contribution towards efforts to decarbonise the energy supply, both in Germany and Europe, marking a key milestone in implementing the German and European hydrogen strategies.

The project also offers clear economic advantages, such as the fact it will replace five High Voltage Direct Current (HVDC) transmission systems that would have had to have been built. The developers stressed it is "by far" the most cost-effective option for transporting large volumes of energy over distances of more than 400km, with attentions now turning to a detailed feasibility study as a first step for the project.

UK's largest electrolyser targeted for outskirts of Glasgow

ScottishPower has unveiled plans to build the UK's largest electrolyser as part of a green hydrogen facility producing up to 8 tonnes of green hydrogen per day.

On 12 April, it announced that it had submitted a planning application for a 20MW electrolyser, as well as a 40MW solar farm and 50MW battery energy storage scheme to power it. It would be located near ScottishPower's Whitelee windfarm and would aim to start supplying hydrogen to the commercial market before 2023. It would have the potential to support Glasgow City Council, as well as local authorities and industries, in their ambitions to create a zero emission vehicle fleet, using just electric and hydrogen-powered vehicles by the end of 2029.

It marks a significant milestone for the Green Hydrogen for Scotland partnership as the first project to be built as part of it. The partnership, launched back in September, is aiming to create green hydrogen production facilities with clusters of refuelling stations across Scotland. A decision on the planning application is expected in autumn 2021.

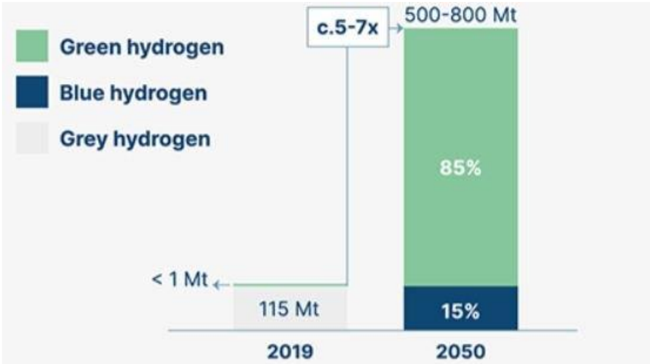
Hydrogen economy key to realising a net zero economy by 2050

A combination of private-sector collaboration and policy support can see the initial ramp up of clean hydrogen production and use reach 50mn tonnes by 2030, a report has said.

On 27 April, the Energy Transitions Commission (ETC) published *Making the Hydrogen Economy Possible,* setting out how clean hydrogen is set to play a complementary role in decarbonising sectors where direct electrification is not possible, such as in long-distance shipping or steel production. It forms part of a wider series of ETC reports, all focused on how to scale up clean energy in the next 30 years to realise a net zero economy.

Figure 4: A 5-7 fold increase in hydrogen production towards net zero

(Source: ETC)

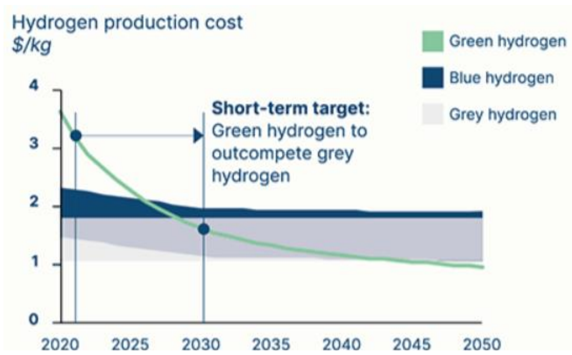


In a 2050 net zero economy, between 500mn and 800mn tonnes of clean hydrogen will be used per annum, with green hydrogen likely the most cost-competitive and, as a result, major production route in the long-term. By 2050, it could account for 85% of total production. However, to realise this, a rapid ramp-up of production and use is needed during the 2020s to unlock cost reductions, bringing clean hydrogen below $2/kg.

While 85% of investments to ramp up hydrogen production will be for renewable electricity provision – over $80tn will be required globally over the next 30 years towards this – an additional $2.4tn is needed for hydrogen production facilities and transportation and storage. Even when clean hydrogen becomes cheaper than grey hydrogen, using it in industry and transport sectors will still impose a "green cost premium" compared to current high carbon technologies. This makes public policy crucial to driving uptake of clean hydrogen at pace, while pulling demand forwards during the 2020s.

Figure 5: Grow production volumes to make green hydrogen competitive

(Source: ETC)



It mapped out actions to take across the value chain to realise this, such as public support and collaborative private sector action to bring key technologies to market; directing investment support and access to low cost capital for clean hydrogen industrial clusters; adapting and expanding existing regulatory and safety frameworks for hydrogen and ammonia; and carbon taxes of $100/tonne by 2030, with further increases until 2050.

It also recommended sector specific policies to create early demand; financial support mechanisms for investments and to overcome the cost premium; improvements to electrolyser technology; the development of rock caverns and depleted gas fields for large-scale hydrogen storage; and efforts to improve the technological readiness of hydrogen use in heavy industry and transport fuels.

Hydrogen key part of decarbonising heat in buildings

Repurposed gas networks carrying hydrogen are set to be a crucial part of the journey to net zero, according to the Energy & Utilities Alliance (EUA).

On 21 April, the EUA published a report, *Decarbonising heat in buildings: putting consumers first*, where it warned that without a choice of different heat technologies for the UK housing stock, decarbonisation of heat will fail. Decarbonising heat for buildings is one of the "biggest challenges" for reaching net zero, with the residential sector emitting 65.2Mt of carbon dioxide (CO_2) in 2019, or 19% of all CO_2.

Figure 6: Suitability of homes to a heat pump

(Source: EUA)

Fossil fuels for heating and cooking are the main source of emissions in the residential sector – 85% (23mn) of homes connected to the gas grid, while 15% use oil or LPG as their main heating fuel or electric heating and over the next 10-15 years, the majority of these systems face having to be replaced. Heat pumps, while important, should be supported by a "mosaic of heating solutions" that include a hydrogen gas network.

Despite 7-10mn homes having no limiting factors to installation of a heat pump, the EUA found 37% to 54% (8-12mn) of homes using gas for heating will not be suitable and while 3-4mn could be made suitable through certain measures, the levels of disruption and association costs that would arise suggest they would be better served through a gas-based technology. Specifically, it called for a blend of locally specific solutions tailored to the needs of housing stock and other geographical features.

In some cases, it suggested that a combination of electrification and hydrogen could prove the best solution. This would see hybrid heat pumps used, combining a hydrogen boiler with an electrically driven heat pump. The hydrogen boiler, which can replace conventional gas ones on a like-for-like basis, has the potential to eliminate carbon emissions from heating completely with water the only by-product.

Having a decarbonised gas network that carries hydrogen, which is zero carbon at point of use, will be key to supporting wider use of heat pumps, it added. This conversion can be done incrementally and with limited disruption to consumers.

The EUA highlighted how a number of trials conducted, focused on hydrogen as a potential option for decarbonising heat, have shown the technical and economic feasibility of such a conversion. This shows hydrogen as a heating fuel, alongside renewable gases more broadly, are a crucial part of the journey to net zero. The UK's hydrogen ambitions should reflect this.

Newly established hydrogen network aims to make Hamburg greener

Twelve companies have joined forces to form the Hamburg Hydrogen Network, which has the potential to realise annual CO_2 savings of over 1mn tonnes.

Unveiled on 26 April, the companies have submitted an application under the EU-wide Important Projects of Common European Interest (IPCEI) support program. The network's projects will make a substantial contribution to emissions reductions, linking hydrogen production, distribution and utilisation across a range of applications.

Combined, these projects could reduce CO_2 emissions in Hamburg by 170,000 tonnes each year as early as 2026, rising to more than 1mn tons annually by 2030, owed to local electrolysis, sea-side imports and connecting to the emerging European hydrogen network. The hydrogen produced from this hub will mainly replace fossil fuels in industrial production, as well as the transport and logistics sector. Additional use of waste heat from electrolysis for the district heating network and thermal treatment of municipal waste will allow a further reduction in the environmental footprint of a variety of industries.

The companies involved are Airbus, ArcelorMittal, Gasnetz Hamburg, GreenPlug, Hamburger Hafen und Logistik, Hamburg Port Authority, HADAG Seetouristik und Fährdienst and Stadtreinigung Hamburg, along with those behind the Hamburg Green Hydrogen Hub – Shell, Vattenfall, Mitsubishi Heavy Industries and Wärme Hamburg.

The green hydrogen hub, which will see a coal power plant in Hamburg-Moorburg converted into a scalable 100MW electrolysis plant was cited as the "foundation" for building a complete hydrogen value chain in Hamburg The Port of Hamburg, meanwhile, with its wide network of potential industrial applications and service partners, offer a unique location-specific advantage to creating a viable hydrogen economy as well.

Waste-to-hydrogen hubs set for roll out across US and world

Hyzon Motors is to collaborate with Raven SR and build waste-to-hydrogen hubs to be rolled out across both the United States and globally.

On 27 April, the partners announced they had signed a memorandum of understanding and are expecting to build up to 100 hubs. These will be able to convert organic waste in almost every form into locally produced, renewable hydrogen for Hyzon's zero emission commercial vehicles. The first hub is being targeted for the San Francisco Bay Area and will be commissioned in 2022.

The hubs will use Raven's steam/CO_2 reformation process, which is non-combustion, low atmospheric and catalyst-free. It converts all types of solid waste into renewable syngas and then into green hydrogen, with costs similar to hydrogen produced using hydrocarbons. In California, it will benefit from the state's Low Carbon Fuel Standard, enabling Hyzon to sell it to third parties at "extremely competitive prices".

The initial hubs will process 50 tonnes of solid waste each per day, yielding up to 4.5 tonnes of renewable green hydrogen. This will be enough to power 100 heavy-duty commercial vehicles. Future hubs will be capable of scaling up to five times larger with larger sites producing 10,000 kilograms of hydrogen per day, powering up to 300 medium to heavy-duty vehicles.

Matt Murdock, CEO of Raven, said: "Our planet produces over 5.5mn tons of municipal solid waste and 16.5mn tons of agricultural waste every single day. Theoretically, if we were to convert all of this waste, we could produce over 2mn tons of renewable hydrogen per day – enough to satisfy over 25% of total global oil demand."

Platts assesses low carbon hydrogen pathways ahead of government strategy

S&P Global Platts has launched a series of UK hydrogen price assessments, ahead of the government's publication of a Hydrogen Strategy later this year.

On 1 April, it explored three different low carbon production pathways for hydrogen: autothermal reforming (ATR) of natural gas with carbon capture and sequestration (CCS), proton exchange membrane (PEM) electrolysis and alkaline electrolysis. Its project data found 26 low carbon hydrogen projects in development, totalling a potential investment of £6.54bn over the next decade, with it highlighting growing interest from investors, policymakers and energy market participants in hydrogen as a carrier for clean energy.

Its calculated hydrogen prices reflected both the commodity production cost and capital expenditure associated with building a hydrogen facility.

It assumed a plant efficiency rate of 68% for ATR with CCS, a capacity factor of 95% and CO2 capture rate of 95%, with the per kW installed capital cost assumption equating to around £646. As for alkaline electrolysis, it assumed an electrolyser efficiency of 67% and capacity factor of 95%, with the assumed cost equating to £631, while for PEM electrolysis, the electrolyser efficiency was assumed to be 58%, capacity factor of 95% and cost equating to £1,003 per kW installed.

SSE and Equinor unveil plans for world's first 100% hydrogen-fuelled power station

SSE Thermal and Equinor have joined forces to develop two first-of-their kind hydrogen and carbon capture projects in the Humber.

On 8 April, they announced the plans are underpinned by a new cooperation agreement between the companies and will support the UK's net zero transition, while accelerating the decarbonisation of the Humber and leading to thousands of skilled jobs. The two decarbonised power stations – Keadby 3 and Keadby Hydrogen – will form a clean power hub near Scunthorpe and be among the first in the world to use carbon capture and storage (CCS) and hydrogen technologies.

Keadby Hydrogen power station will have a peak demand of 1.8GW of hydrogen, producing zero emissions at the point of combustion. It will be the first major power station in the world that is 100% hydrogen fired and secure at-scale demand for hydrogen in the region for decades to come. If appropriate policy mechanisms are in place, it could come online before the end of the decade, accounting for a third of the government's 5GW hydrogen production goal.

Keadby 3, meanwhile, will be a 900MW power station fuelled by natural gas with carbon capture technology fitted, removing CO2 from its emissions. This captured CO2 will then be transported through shared pipelines before being stored under the Southern North Sea. It has the potential to come online by 2027 and could deliver 15% of the target of 10MT of carbon captured annually by 2030. Both projects would use the parallel hydrogen and CO2 pipeline infrastructure under development from the Zero Carbon Humber (ZCH) partnership, as well as the offshore CO2 infrastructure being developed by the Northern Endurance Partnership (NEP).

Both Keadby Hydrogen and Keadby 3 are in the development stage, with SSE Thermal and Equinor to continue engagement with government, regulators and stakeholders ahead of final investment decisions being made, subject to the progress of policy frameworks.

Stephen Wheeler, MD of SSE Thermal, said: "With over 12mn tonnes of annual carbon emissions, ideal transport and storage options, and major energy and industrial companies working together, the Humber has to be at the centre of the UK's decarbonisation strategy."

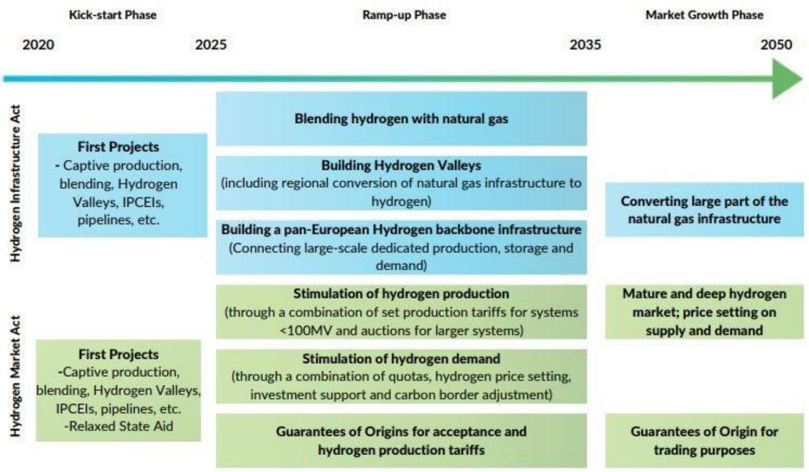
Paper makes case for "Hydrogen Act" for Europe

Hydrogen must become a central pillar of the energy system with a dedicated framework, a report has said, proposing a "Hydrogen Act" for Europe.

On 7 April, Hydrogen Europe published a paper, outlining how the European Hydrogen Strategy was a first step towards success but now that ambition must be translated into reality. The current policy and regulatory elements for hydrogen are spread across gas, electricity, fuels, emissions and industrial frameworks, leading to limited overarching coordination. A Hydrogen Act would harmonise and integrated all of these separated hydrogen-related actions and legislations, serving as a vision for an umbrella framework.

Figure 7: Overview of a "Hydrogen Act"

(Source: Hydrogen Europe)



Its proposed Hydrogen Act focuses on developing both a sophisticated European hydrogen infrastructure that has replaced large parts of the natural gas network and a mature market for affordable, reliable hydrogen that has replaced natural gas and other fossil fuels. It is broken down into three phases of development, beginning with a kick-start phase.

During this phase, the foundations of the European hydrogen economy will be laid. A fast track approach will have to be adopted to achieve goals, owed to the absence of a clear and harmonised EU framework for hydrogen and lack of competitiveness in key applications, with exceptions and derogations from existing EU rules required for a limited period of time. This would include relaxing or reforming EU state aid rules in a bid to facilitate growth in the number of projects and close the initial cost gap.

The period 2025-2035 would be considered a ramp-up phase where the supporting framework will strive to facilitate key elements of the European hydrogen economy. Large-scale storage and hydrogen backbones will be constructed, with captive solutions and hydrogen valleys realised as appropriate supportive measures stimulate supply and demand. Most applications for hydrogen will require some form of regulatory support, such as tariffs, auctions, tenders, quotes, investment support, tax relief, supported by Guarantees of Origin (GO), which will become a tradable commodity.

Once hydrogen has achieved commercial competitiveness with conventional production and alternatives, many of the support frameworks of the previous phases will become obsolete, leading into a market growth phase from 2035 onwards. The hydrogen market will be transparent and liquid, with price-setting largely driven by mechanisms of supply and demand. Regulation of the market will be needed as network integration deepens in a bid to avoid monopolistic behaviour and ensure interoperability.

Hydrogen must be on the agenda for the next Scottish government, says ENA

The Energy Networks Association (ENA) has called for the upcoming Scottish government hydrogen action plan to set a clear statement of ambition on hydrogen as a zero carbon heat solution, giving industry and investors the confidence to drive ahead with projects.

On 26 April, the ENA published a manifesto ahead of the forthcoming Scottish Parliament election on 6 May, outlining the networks' priorities for supporting the new government in addressing the climate challenge. This includes making Scotland an international centre for green gas, with the hydrogen action plan a key element of this. This should incorporate detailed plans for hydrogen production, reflecting Holyrood's 5GW target for 2030. The networks will also look for support for key hydrogen R&D projects, such as future phases of H100 Fife and Aberdeen Vision, among others.

For Scotland's hydrogen industry to get off to a quick start, it further suggested introducing sectoral targets. This would drive the take-up of hydrogen in parts of the economy that are hard to decarbonise, while hydrogen can also offer a transition for skilled workers currently focused on fossil-based industries into a growing green sector.

Other priorities for the networks include aligning the RIIO framework with Scotland's energy plans, refining the planning system to support the infrastructure of the future and driving the nationwide roll-out of electric vehicle infrastructure. Ensuring Scottish homes are heated efficiently and without carbon was also cited as key, with the ENA noting the Scottish government's recently published *Heat in Buildings Strategy* set a target for 1mn homes heated by gas to be converted to low or zero carbon heating by 2030 as part of efforts to meet an interim 75% emissions reduction target set in law, which has cross-party support.

While electric heat pumps have been put forward as the main way of achieving this, supported by heat networks, the ENA called for greening the gas network to be considered as a viable alternative where heat pumps are not the most appropriate solution. This optionality over technologies available is not only critical to meeting net zero, but also engaging customers and ensuring they are brought along on the net zero journey.

With this in mind, it called for the *Heat in Buildings Strategy* to reflect a hydrogen-heated homes target for 2030 as a key part of 2030 heat targets and equivalent numbers of homes on biomethane or blended hydrogen towards the 2030 heat target.

Construction commences on hydrogen pilot plant

Construction is underway on a 1.5MWth pilot plant to test an innovative hydrogen production technology at Cranfield University.

On 13 April, Cranfield University announced that the HyPER project, which is an international collaboration it is leading with £7.4mn funding from the BEIS Energy Innovation Programme, will examine the potential for low carbon hydrogen as the key clean fuel of the future. Doosan Babcock and GTI are also involved, with the project centred on a hydrogen production technology invented by the latter.

GTI's technology captures CO2 during the hydrogen production process, before shifting the chemical reactions to favour production of more hydrogen. The resulting outputs are high purity streams of hydrogen and carbon dioxide which can be stored, sold or transported to where they are needed. The pilot plant will aim to demonstrate key components of this process that can enable future scale-up and lead to commercially operating facilities.

The plant is set to be operational by the autumn.

Shell unveils hydrogen objectives on path to net zero

Shell has set out how it plans to reach net zero emissions by 2050 with the publication of its Energy Transition Strategy.

On 15 April, it presented the strategy ahead of it being put to shareholders for an advisory vote at its AGM on May 18. It set out a series of targets as it progresses to becoming a net zero energy business by 2050, reducing its carbon intensity by 2-3% in 2021, rising to 20% by 2030, before climbing to 100% by 2050, while cutting absolute emission from 1.7 gigatonnes CO2e per annum (gtpa) as of 2018 to zero in the same timeframe.

The strategy further outlines a set of 2030 milestones, including goals to produce eight times more low carbon fuels, such as biofuels and hydrogen, by 2030 and increase low carbon fuel sales to more than 10% of transport fuels. On hydrogen specifically, Shell stated that while the clean hydrogen market remains in the early stages and volumes are modest, it sees "strong potential for growth", especially in hard-to-abate sectors of the economy. Its goal is to achieve a double-digit market share of global clean hydrogen sales by 2030.

It will build on its leading position in hydrogen and develop integrated hydrogen hubs which will, at first, serve industry and heavy-duty transport. It will begin by producing and supplying hydrogen for its own manufacturing sites, especially refineries, such as in Rheinland in Germany. Here, Shell is developing a hydrogen electrolyser at its refinery, while it will also continue working to extend its network of hydrogen retail stations with an increasing focus on heavy-duty transport.

Australia unveils backing for hydrogen and carbon capture projects

The Australian government is to invest in clean hydrogen and carbon capture technologies, supporting Australian industry and manufacturing into the future.

On 21 April, it announced that the 2021-22 Budget will see AUS$539.2mn invested in new clean hydrogen and carbon capture, use and storage (CCS/CCUS) projects, creating around 2,500 jobs and further driving down Australia's emissions. It has allocated AUS$263.7mn to CCS/CCUS projects and AUS$275.5mn to accelerate the deployment of an additional four clean hydrogen hubs in regional Australia – plans for a network of hydrogen technology clusters were unveiled in February – and implement a clean hydrogen certification scheme.

The plans fall under Australia's Technology Investment Roadmap, which is aiming to cut emissions and reduce energy costs, driving at least AUS$70bn of total new investment into low emissions technologies in Australia by 2030.

Uniper targets national hub for hydrogen in Germany

Uniper is planning to establish a German national hub for hydrogen in Wilhelmshaven and is working on a corresponding feasibility study.

On 14 April, it announced its plans for *Green Wilhelmshaven*, including an import terminal for green ammonia which would be equipped with an "ammonia cracker" that can produce green hydrogen and will also be connected to the planned hydrogen network. A 410MW electrolysis plant is also part of the plans which, combined with the import terminal, could provide 10% of the demand expected for the whole of Germany in 2030.

Uniper COO, David Bryson, said: "We need to get hydrogen out of the laboratory and start using it in large-scale applications and marketable industrial solutions — we should make it into a commodity and exploit its wide variety of uses. One way of achieving this is to import green ammonia and convert it into hydrogen, which is something we are looking at for Wilhelmshaven."

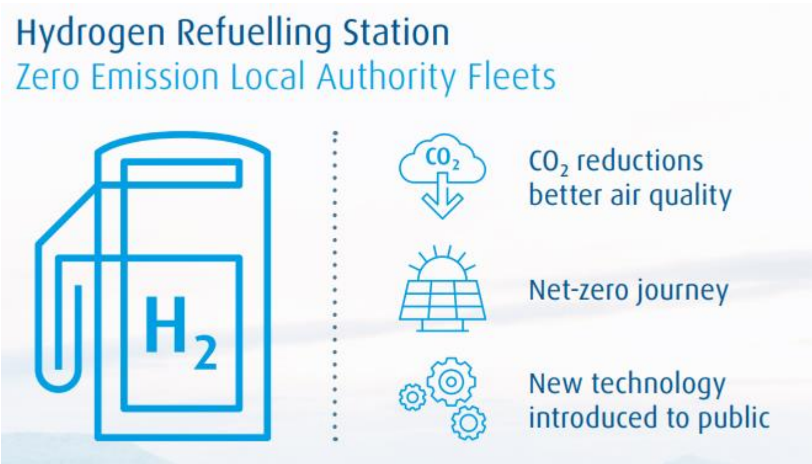
Guide looks at key considerations for councils considering hydrogen transport

BOC has prepared a guide for councils and local authorities looking to use hydrogen as an effective way of decarbonising transport on route to net zero.

The guide – which is available for free here – sets out how while three quarters (74%) of councils have declared climate emergencies in the UK as of October 2020, the challenge for many of them is now acting on that declaration, which will include driving private and public transport to zero emissions. Forward-thinking councils are working with partners in a bid to deliver clean transport alternatives for bus fleets and service vehicles, with the guide striving to support councils and local authorities considering using hydrogen hubs as a means of decarbonising transport.

Figure 8: Advantages of hydrogen transport

(Source: BOC)



Hydrogen hubs can deliver CO2 reductions, better air quality while serving to introduce the technology to the public. It cited the Kittybrewster bus depot in Aberdeen as a case study, where BOC has worked with Aberdeen City Council to develop, install and operate the UK's largest and highest performing hydrogen refuelling station.

Having opened in 2015 for single-decker buses, it now offers refuelling for all private and public hydrogen vehicles, producing enough hydrogen a day for each of the current fleet of ten 42-seat buses to travel up to 350km. It has saved over 1,500 tonnes of CO2 in five years, is reliable with a 99.5% performance, ensures no engine noise from vehicles and fast refuelling – 10 minutes for a bus, 5 minutes for a car – with onsite electrolysis.

However, despite the benefits of the Kittybrewster site and hydrogen hubs in general, the guide laid out a series of key considerations for councils, including whether hydrogen suits the type of vehicles they operate and if the council operates a vehicle fleet large enough to make investment in hydrogen refuelling worthwhile. While capable of operating on a small scale, the economics change dramatically when the facility is scaled up with the cost per kg of hydrogen falling as volumes increase.

It also called for consideration of how large the hydrogen storage and refuelling facility should be, as well as how it will be funded; if there is a suitable site available in the region for a hydrogen storage and refuelling facility; and whether there are renewable energy assets in the region that could supply clean electricity.

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