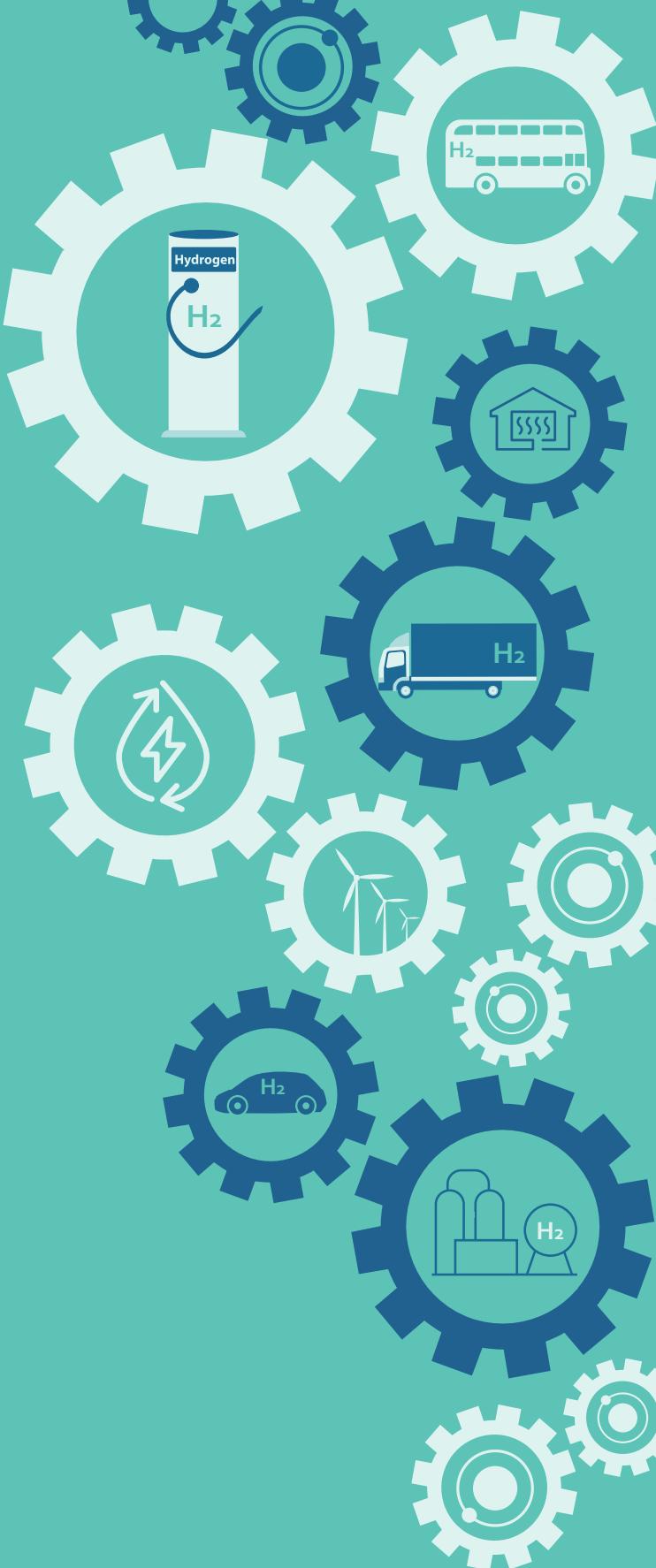


# The role of hydrogen in powering industry

APPG on Hydrogen report



All Party Parliamentary Group on  
**Hydrogen**

This report was researched by Connect and funded by Baxi, Bosch, Cadent, EDF Energy, Energy and Utilities Alliance, Equinor, Johnson Matthey, National Grid, Northern Gas Networks, SGN and Shell. This is not an official publication of the House of Commons or the House of Lords. It has not been approved by either House or its committees. All-Party Parliamentary Groups are informal groups of members of both Houses with a common interest in particular issues. The views expressed in this report are those of the Group.

The APPG on Hydrogen is sponsored by:



# Foreword



Jacob Young MP  
Chair  
APPG on Hydrogen

Hydrogen has a key role in powering industry, if we are to meet the Government's net zero targets, we must quickly put in place the right policy levers and infrastructure to support businesses looking to do the right thing.

There is no doubt that there are huge opportunities from decarbonising industry, from industrial heating to green steel. I am delighted to hear from many businesses who are innovating in creating low-carbon technologies to support the roll out of hydrogen, whilst enhancing the opportunities for the creation of high-skilled, green jobs.

The UK can become a global leader in hydrogen technology whilst exporting its successes on an international scale. With COP26 later this year, and the Hydrogen Strategy, Heat and Buildings Strategy and Net-Zero Strategy expected to be published shortly, there have never been more exciting opportunities for the Government to expand beyond its existing commitments for 5GW Hydrogen production to level up and support the creation of green jobs whilst delivering for the UK economy and our long-term environmental aims.

The APPG received just over 70 responses to its call for evidence, hearing from organisations about how they are contributing to a greener future and the changes they require to ensure that hydrogen plays a fundamental role in reducing carbon emissions.

The APPG has set out measures that can be taken to support the overall delivery of decarbonising industry through hydrogen and establishing the UK as a global leader in hydrogen technology.

If you would like more information on the APPG, please contact the secretariat on [appghydrogen@connectpa.co.uk](mailto:appghydrogen@connectpa.co.uk) and follow us on Twitter [@HydrogenAPPG](#).

# Introduction

The APPG on Hydrogen is chaired by Jacob Young, MP for Redcar and has a total of 31 parliamentary members. It provides a forum for MPs and Peers to engage with leading businesses and organisations that are working to enable the UK to meet its decarbonisation targets through the implementation of hydrogen projects, and to discuss policy options to support these.

The APPG's sponsors are Baxi, Bosch, Cadent, EDF, Energy and Utilities Alliance, Equinor, Johnson Matthey, National Grid, Northern Gas Networks, SGN and Shell.

A large-scale conversion to hydrogen has the potential to:



## **Position the UK as a global leader in hydrogen technology**

The UK is already seen to be the most advanced in its research and testing on the potential of hydrogen. We must move fast to solidify this position and ensure we are not left behind.



## **Drastically cut carbon emissions**

Hydrogen has the potential to reduce large amounts of carbon emissions in several areas including throughout industrial processes and the way we heat our homes and businesses. This is likely to cause less disruption and upfront costs for customers moving to alternatives.



## **Create and sustain thousands of skilled jobs in all parts of country**

Parliamentarians from all areas of the UK are members of the APPG, while unions such as UNISON and GMB are strong supporters of hydrogen.



## **Unlock innovation in other sectors**

Hydrogen technology can lead to greater production and rollout of hydrogen cars, trains, buses, lorries and ferries, as well as in heavy industry and domestic appliances.

# What is hydrogen?

Hydrogen is a gas that can be combusted in a way that produces no greenhouse gas emissions. It can be produced through electrolysis of water or by reforming methane, where the carbon dioxide generated can be captured and stored.

Many organisations are currently looking at hydrogen as a source of low carbon energy and as a key solution towards supporting the Government's net zero targets. Some businesses assessing hydrogen's potential are exploring the creation and delivery of hydrogen through carbon capture, utilisation and storage (CCUS) (also referred to as blue hydrogen), nuclear energy and renewable energy such as offshore wind (also referred to as green hydrogen).

The UK has the potential to become a world leader in this sector. It has a long history of leading in developments on gas technology, a large workforce linked to the gas industry and as an excellent safety record. It also has experience in gas conversion, and an integrated gas network already largely adapted to be hydrogen ready.

In a clear display of the enormity of the challenge, research by the think tank Onward found that the Government will fail to deliver on its commitment to net zero by 2050 without taking radical action and setting clear policies to decarbonise the 12 most carbon-intensive industries, which together represent three-fifths of UK emissions and employ one in every five jobs.

This research was also supported by Hydrogen Strategy Now's 'State of the Hydrogen Nation' survey which found that the lack of a clear Hydrogen Strategy has seen the UK miss out on valuable investments into UK hydrogen projects, while 81 per cent said the UK was failing to meet its hydrogen potential.

The Government has the opportunity in the forthcoming Hydrogen Strategy to affirm its leadership in hydrogen technology whilst showcasing leading homegrown technologies in the run up to COP26 to promote the UK's hydrogen potential internationally.

## Reasons why the UK should become a global leader in hydrogen technology

- ✓ Existing infrastructure for gas storage with an excellent safety record
- ✓ Demonstrable achievements in scientific and engineering innovations
- ✓ Skilled professionals, resources, companies and academic/research facilities
- ✓ UK financial services and proximity to European markets

The findings also demonstrate that more than three-quarters of respondents to the survey said the 5GW hydrogen production target set out in the PM's Ten Point Plan is not ambitious enough. This is supported by research from the Hydrogen Taskforce which believes that there is potential for 22.9GW of Hydrogen to be produced by 2030.

The Government has the opportunity in the forthcoming Hydrogen Strategy to affirm its leadership in hydrogen technology whilst showcasing leading homegrown technologies in the run up to COP26 to promote the UK's hydrogen potential internationally. **The Government must continue to expand beyond its existing commitments of 5GW production in the forthcoming Hydrogen Strategy.** This should mirror industry's ambition for hydrogen and support the creation of green jobs for the UK economy.

## case study

# Johnson Matthey

At Johnson Matthey, our vision is for a world that's cleaner and healthier, for today's and future generations. As a global leader in sustainable technologies for over 200 years, we apply our cutting-edge science to create solutions with our customers that make a real difference to the world around us.

The hydrogen market is not new to us – we have been a leader in hydrogen activities for decades. Our offer today includes market leading hydrogen production catalysts and processes, components for hydrogen fuel cells, catalyst coated membranes (CCMs) for electrolysis, and new technologies for Low Carbon Hydrogen production.



### Blue Hydrogen

Manufacturing blue hydrogen at scale is an essential early step in reducing global carbon dioxide emissions and supporting the transition to net zero. Our innovative LCH™ Technology has been selected for the UK's HyNet project and is a technology in which we are seeing significant commercial interest.

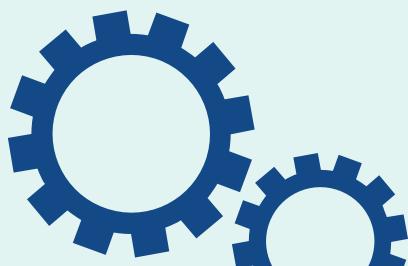
### Fuel Cells

We have an established business specialising in Fuel Cell components, where we develop and manufacture tailored membrane electrode assemblies at scale for global Tier 1s and OEMs. Our technology is powering vehicles on the road today, including 800 buses and 150 heavy commercial vehicles in China.

### Green Hydrogen

Our green hydrogen business unit builds on the capability of our fuel cells business and the scientific and technological expertise supporting it, by focusing on the manufacture of catalyst coated membranes for electrolyser systems.

To enable a sustainable energy transition, we are also building on our position as the world's largest secondary refiner of platinum group metals (pgm's) to drive the creation of closed loop recycling systems.



# Recommendations

1. **The Government must continue to expand beyond its existing commitments of 5GW production in the forthcoming Hydrogen Strategy.** This should mirror industry's ambition for hydrogen and support the creation of green jobs for the UK economy.
2. **Any forthcoming Government and devolved policies must be complementary of the wider UK low-carbon commitments.** Government departments must work together in creating streamlined, ambitious strategies to support the overall delivery of hydrogen at scale, supporting the implementation of both blue and green hydrogen.
3. **The Government must commit to incentivising hydrogen production within the UK as opposed to importing this.** This will be key in creating and sustaining green jobs across the UK whilst maximising supply chain opportunities and supporting the Government's levelling up ambitions. This must be supported through the right training, skills, and research to coincide with the introduction of the emerging hydrogen economy.
4. **The Government must align hydrogen production pathways with nuclear technology to enhance hydrogen production.** Strategic planning will be required to store and transport hydrogen safely and efficiently.
5. **A UK wide hydrogen network to support the transport sector is required, including a larger-scale implementation of hydrogen refuelling stations.** The Government must develop incentives to help shipping and other transport organisations move away from diesel fuels to hydrogen alternatives.
6. **Industrial clusters will be the key catalyst for driving forward the UK's decarbonisation of industry with hydrogen and should be an immediate priority for the Government.** These clusters can take advantage of economies of scale and sharing a common infrastructure.
7. **Changes in regulation by the Government are required to support hydrogen's role in powering industry.** This includes blending hydrogen and amending the Gas Safety Management Regulations to allow hydrogen injection in the domestic grid. This should be further supported through providing the market with clear signals of using hydrogen technology such as mandating the development of hydrogen-ready boilers and meters by 2025.
8. **For hydrogen to expand in the UK, a technology neutral approach is required for all types of energy systems.** This must ensure a level playing field exists to support hydrogen and maximise the complementary technologies in achieving net zero. Carbon contracts for difference will be an important instrument to reward climate-friendly technologies.
9. **Significant and long-term financial support is required for the development, deployment and operation of hydrogen technologies.** This must include the funding available for shovel-ready hydrogen projects.
10. **Ofgem must ensure the hydrogen market is subject to effective competition to drive down prices for consumers.**

## case study

# Baxi Heating



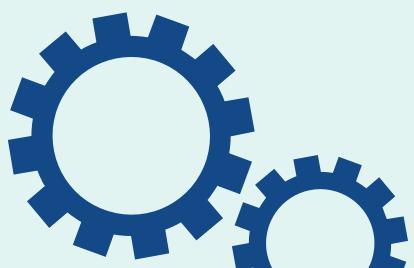
In the UK and Ireland, Baxi Heating has a portfolio of some of the best-known brands in the heating industry, with a proud history of UK manufacturing for over 150 years.

As part of BDR Thermea Group, Baxi Heating makes considerable capital investment in research and development resources, focusing on energy saving and low carbon technologies to tackle the decarbonisation of heat, including pioneering work in the development of hydrogen boilers.

This ground-breaking development initiative has produced prototype wall hung combination and system boilers designed to operate on 100% hydrogen, thereby producing zero CO<sub>2</sub> and CO emissions during operation.

The boilers use the same outer case dimensions and pipe connection points as existing natural gas boilers in order to facilitate as much as possible a “*like for like*” changeover. Crucially, this means that installation of ‘hydrogen ready’ boilers could begin long before 100% hydrogen is available within a locality by utilising the existing natural gas network, with a simple conversion process needed at the point of network changeover.

An initial trial of an operational hydrogen boiler in a real-life situation began in Rozenburg, the Netherlands, in 2019. Further refinement and development of the hydrogen boiler concept are being demonstrated in the UK through the Hy4Heat programme.





# The role of hydrogen in powering industry

In 2018, the UK Government committed to bring all greenhouse gas emissions to net zero by 2050. In doing so, the UK became the first major economy in the world to pass legislation to end its contribution to global warming.

Reaching this target requires extensive change across all sectors. And there has been progress to date. For example, recent analysis has shown that coal now accounts for less than 2% of all electricity generated in the UK, with coal use collapsing 93% since 2015.

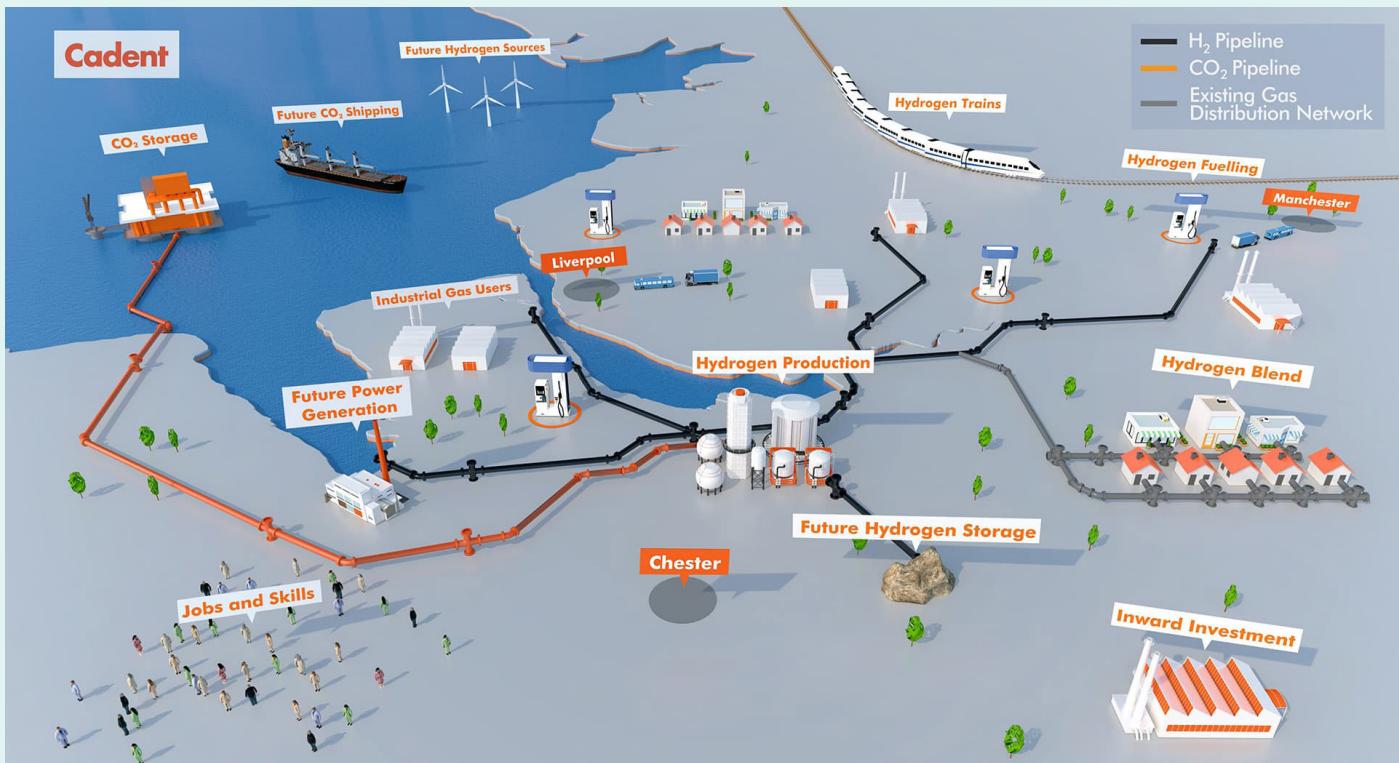
Whilst there has been clear and world-leading progress in areas like electricity supply, the pace of change has been slower in industry. The Committee of Climate Change (CCC), in its 2020 progress report to Parliament, stated that industry accounted for 21% of all UK emissions in 2019 and that industrial decarbonisation policy must be more strategic and move faster. Research released from the IEA Net Zero by 2050 report recommends that fuel-switching to hydrogen and carbon capture can both play a major role in decarbonising emissions from industry.

Decarbonising industry across UK will be one of the most challenging and critical sectors to achieving net zero greenhouse gas emissions by 2050. It will require a range of energy solutions and policy levers to ensure the UK remains competitive for business but also meets the Government's net zero targets.

Hydrogen has a vital role to play in those hard-to-reach sectors of the UK economy, including the manufacturing industry, heating of buildings and heavy transport. With the right framework and infrastructure in place, hydrogen has the potential to provide between 25%-50% of Britain's energy supply by 2050, supporting the overall delivery of net zero.

## case study

# Cadent HyNet



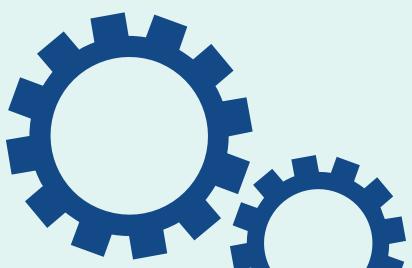
HyNet North West is driving the low carbon energy transition across the North West of England and North East Wales. This integrated low carbon hydrogen and CCUS industrial cluster is being delivered by a consortium comprised of Cadent, Progressive Energy, Eni, Essar, CF Fertilisers, Hanson, University of Chester and INOVYN.

The region is home to the largest concentration of advanced manufacturing and chemical industries in the UK, making many well-known products and brands. More than 30 are working with HyNet, recognising that it offers a world-leading route to sustainable prosperity in the future low-carbon economy.

From 2025, HyNet North West will produce, store and distribute hydrogen as well as capturing and storing CO<sub>2</sub>, through the creation of state of-the-art infrastructure. This includes the delivery of the UK's first low carbon hydrogen production hub which will manufacture 3TWh of hydrogen each year. This will be transported for use by industry and low carbon power generators across the HyNet region through the UK's first hydrogen pipeline network.

By 2030, over 30TWh per year of hydrogen will be delivered to customers across the region using the 350km of new-build hydrogen pipelines. It will be integrated with over 1TWh of underground salt cavern storage to provide reliable and secure low carbon energy supplies.

HyNet North West is at the forefront of the UK's journey to a Net Zero future, enabling rapid and deliverable energy transition across the region.





# Opportunities from the UK's Industrial Decarbonisation Strategy

The Industrial Decarbonisation Strategy is the first strategy published by a major economy setting out how industry can decarbonise in line with net zero while remaining competitive and without exporting emissions abroad. The strategy sets out the Government's vision for a prosperous, low carbon UK industrial sector in 2050, and provides industry with the long-term certainty it needs to invest in decarbonisation.

The Government states that to keep industry on the journey to net zero and meet its carbon budgets and nationally determined contribution under the Paris Agreement, it expects that emissions need to fall by around two thirds by 2035, delivering this in a way that capitalises on clean growth opportunities. The strategy recognises that hydrogen energy can play an important role in delivering the Government's targets and notes that over the next decade, the UK will begin the journey of switching away from fossil fuel combustion to low carbon alternatives such as hydrogen.

The strategy notes that with low carbon hydrogen and CCUS at early stages of development, the Government will need to play an active role in overcoming market failures and sharing the risk and costs of scaling up deployment of both technologies.

**It is essential that any forthcoming Government and devolved policies must be complementary of the wider UK low-carbon commitments. Government departments must work together in creating streamlined, ambitious strategies to support the overall delivery of hydrogen at scale, supporting the implementation of both blue and green hydrogen.**

## case study

# Bosch

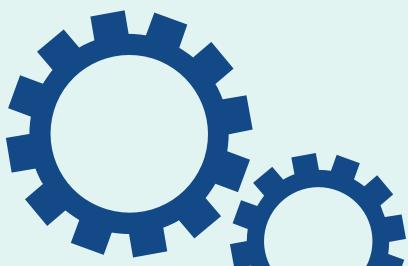
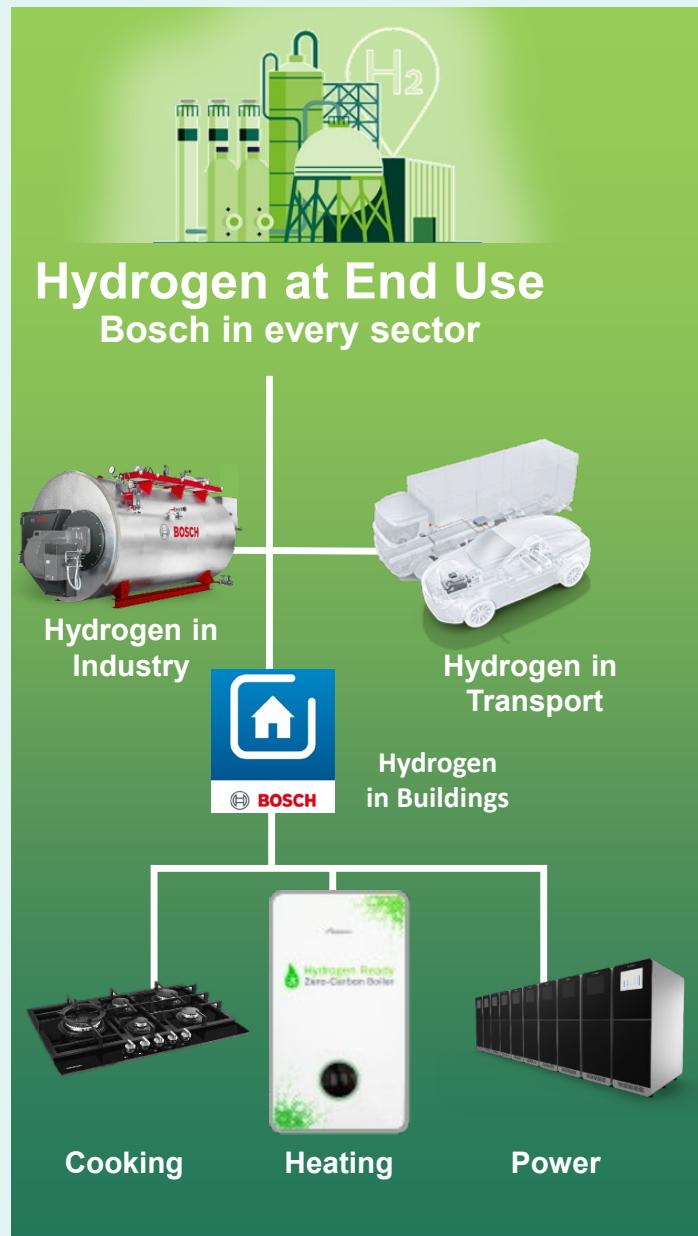
At Bosch we are focused on demonstrating and realising the use of hydrogen to decarbonise the heat network. Domestic heating accounts for 15% of total UK CO<sub>2</sub> emissions and the UK has a unique opportunity to harness hydrogen, given that 85% of homes across the country are connected to the gas network.

At our R&D site in Worcester, Bosch has developed prototype domestic boilers to replace existing natural gas models that can quickly be converted to run on pure hydrogen.

It is now widely accepted that the route to decarbonisation will be a combination of hydrogen and electrification, with heat pumps targeted towards new build properties and boilers running on hydrogen in a large proportion of existing buildings.

The UK has one of the largest heating markets in the world with around 1.6 million boilers installed a year and a thriving manufacturing industry for boilers. In the event of a transition to hydrogen, the UK can – if it acts now – be in a world leading position to export hydrogen boilers. The worldwide market for gas boilers is 13.8 million units a year with a value of £6 billion. For instance, in China 3.6 million boilers are sold per year, whilst in South Korea it is 1.2 million.

The UK currently has an early advantage. The Department for Business, Energy and Industrial Strategy is already supporting early-stage development of domestic hydrogen-ready appliances, and OFGEM-funded community trials, planned for 2022, will bring the technology to deployment. With economies of scale, the clear cost benefits of hydrogen-ready boilers can be fully realised for UK consumers. However, the transition requires legislative coordination and impetus, and the UK's advantage will be quickly eroded unless the Government unequivocally backs hydrogen-ready technology. The Government must urgently deliver a legislative roadmap that provides clear direction and a coordinated transition from natural gas to hydrogen-ready boilers.



# Hydrogen production

To ensure sufficient supply to meet demand, the UK must ramp up its existing hydrogen production, combining it with CCUS to keep carbon dioxide levels low. To support the Government's twin-track approach of blue and green hydrogen, it must also have the right infrastructure in place for green hydrogen production from renewable energy.

Strong policy support will be needed for CCUS to produce hydrogen at scale and reach the cost targets for emissions-free hydrogen production. The Government must provide incentives and investments for those implementing CCUS to become commercially viable.

The UK is also uniquely placed to be a leader in the development of hydrogen production from offshore wind. This is due to the levels of offshore wind resources available and currently being created throughout the UK.

The most significant barrier for renewable hydrogen is the cost of electrolyzers. The shortage of large-scale facilities has meant an underdeveloped supply chain, which has made equipment and production costly.

Establishing a substantial hydrogen infrastructure will require the development of sufficient transport and storage facilities. The development and expansion of methanol and ammonia in the UK will present exciting opportunities both locally and internationally.

This could also be further aligned through the growing nuclear sector in the UK, particularly through large-scale and small modular reactors as well as advanced modular reactors. It has been recognised that aligning hydrogen production with nuclear technology will support the overall delivery of hydrogen's role in decarbonising large carbon emitting industrial sectors. The development of nuclear and hydrogen innovation can unlock clean energy technologies to deliver the scale required for supporting the Government's net zero targets. **The Government must align hydrogen production pathways with nuclear technology to enhance hydrogen production.** This will help achieve low prices from electrolysis in the short and medium term. Strategic planning will be required to store and transport hydrogen safely and efficiently.

New investment will also be required in hydrogen production facilities, storage tanks and pipelines. UK investment in electrolyser production facilities will help to catalyse the UK's export potential and feed a world demand for hydrogen. Upgrading existing technologies and local grid connections will also be essential in delivering large-scale hydrogen production.

## case study

# Shell



Hydrogen is one of the most abundant elements in the universe and could play a significant role in the transition to a clean and low-carbon energy system. Shell has a growing network of hydrogen stations in Europe and in North America, where it is part of several initiatives to encourage the adoption of hydrogen in transport.

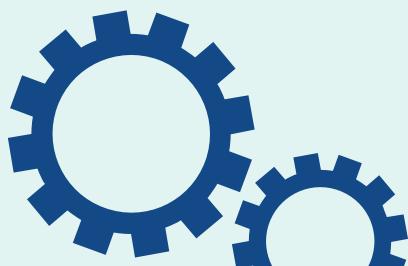
In Germany, Shell is part of a joint venture called H2 Mobility with industrial gas manufacturers Air Liquide and Linde', car manufacturer Daimler, and energy companies Total and OMV to develop a nationwide network of hydrogen refuelling stations, and is expanding this in the UK.

In 2017, Shell became the first branded fuel retailer to sell hydrogen at one of its retail sites in the UK. The hydrogen refuelling stations in Cobham and Beaconsfield, in partnership with ITM, use hydrogen produced on site using electricity from renewable sources.

As a global organisation, Shell has also been part of a Californian consortium to develop three new large-capacity refuelling stations for heavy-duty hydrogen fuel-cell trucks being developed by Toyota and Kenworth Truck Company. One of these stations will use hydrogen made from biogas, which is natural gas made from renewable sources.

In 2017, Shell published a study on the future of hydrogen in the transport sector and concludes that in 2050, 113 million fuel cell electric vehicles (FCEVs) could save up to 68 million tonnes of fuel and almost 200 million tonnes of carbon emissions, making a significant contribution to reducing energy consumption and greenhouse gas emissions in the transport sector.

Collaboration between vehicle manufacturers, energy companies and government is vital for progressing the infrastructure to make any emerging fuel a viable alternative. Hydrogen is no exception.



# Hydrogen in transport

Decarbonising transport is a monumental task, and long-term strategic Government policies will be essential to enable fuel switching that will help to drive market demand for hydrogen supply by 2050.



## Heavy Goods Vehicles (HGVs)

The CCC's Net-Zero Report identified that hydrogen is particularly important for the HGV sector. It has a key role to play in powering heavy and medium transport. However, a UK wide network to support the haulage sector is required, including a larger-scale implementation of hydrogen refuelling stations.

For hydrogen to succeed as a transport fuel, there must be an increase in the number of hydrogen refuelling stations. Companies such as PowerHouse Energy are implementing technology that uses non-recyclable plastic waste to create hydrogen fuel to decarbonise trucks and buses.

Fuel cells also play a prominent role in supporting the roll out of hydrogen HGVs. The UK is a leader in creating fuel cells and has several world leading manufacturers and supply chain businesses, that with the right support could become global leaders and engines for economic growth to support the UK's economy.

There are also opportunities to use hydrogen in fleet transport such as taxis where the total cost of ownership is much lower.

The Government should amend the Renewable Transport Fuel Obligation to encourage hydrogen use in transport.



## Shipping

Hydrogen can play an instrumental role in reducing carbon dioxide emissions in shipping industry where electrification through batteries is currently unavailable.

This could be done via hydrogen and ammonia which is recognised in the CCC's Net-Zero Report, which notes that shipping requires 75% or 100% uptake of ammonia to meet net zero targets. The



## Rail

The rail industry is already an environmental, efficient means of public transport but still contributes to greenhouse gas emissions. There are currently 2,400 diesel powered vehicles on the rail network, which the Government is committed to removing by 2040. Hydrogen makes an ideal replacement for diesel, and hydrogen trains could easily take the place of half that fleet.

The key challenge that the rail sector faces is the absence of a long-term strategy from the Government in achieving this. The Transport Select Committee report from March 2021 recognises this and recommends the Department for Transport publishes a long-term strategy for decarbonising the rail network as a top priority. The long-term strategy must also include a clear vision for the proportion of the rail network that is expected to use electrification, batteries, or hydrogen. This will support operators in developing a credible delivery plan whilst enabling key targets and milestones.

Many businesses in the rail sector are currently undergoing trials using hydrogen electrolyzers to deliver hydrogen. Porterbrook has invested over £7 million in the development of HydroFlex, the UK's first hydrogen powered train, and will continue investing with the right commercial opportunity and regulatory framework in place.

global nature of shipping will require international cooperation on how best to decarbonise the sector.

The UK currently only has 13 hydrogen filling stations, there needs to be incentives in place to help shipping and other transport organisations move away from diesel fuels to hydrogen alternatives.

## case study

# EUA

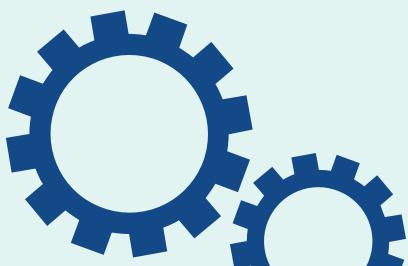
A number of high-profile projects are underway to explore the feasibility of hydrogen. Owing to its position within the industry, The Energy and Utilities Alliance (EUA) has used its knowledge and expertise to support a number of these projects in finding practical solutions to delivering a decarbonised gas supply.

Specifically, the Heating and Hotwater Industry Council, HHIC (a division of EUA) has worked in collaboration with boiler manufacturers to develop 'hydrogen ready' products, together with guidance on the effects of introducing a blend of hydrogen into the natural gas supply. Their members have been at the forefront of 'Hydrogen for Heat' development with several of the members already having hydrogen ready appliances that can be converted to hydrogen in under an hour, with little or no difference to upfront consumer costs.

EUA is also an active participant in a range of Hydrogen studies such as Hy4Heat, THyGA, and HyDeploy.

EUA and its utility network members have already started working on gas networks innovation trials such as HyNet, H21, and the Freedom Project. The industry is poised to deliver.

The flexibility offered by the gas networks, together with the innovative work of the domestic and commercial boiler manufacturers and green gas transport providers, all supported and coordinated by EUA, means that hydrogen offers a solution to meeting UK climate goals whilst maintaining demand.





# Hydrogen in the food and drink sector

The Food and Drink sector is the fourth largest emitter of greenhouse gases in the UK industry, accounting for almost 8.4 million tonnes a year, according to the Department for Business, Energy and Industrial Strategy.

As recognised by Protium, there are vast opportunities available for decarbonising industries not on the gas system, particularly those that are less sensitive to energy pricing and where consumer pressure for transition is the greatest, such as the food and drink sectors.

These industries can account for over 10% of UK exports and employ over 1.2 million people across the broad supply chain. Hydrogen produced by renewable energy can support the rapid decarbonisation of the UK industry while retaining manufacturing competitiveness internationally and creating new industrial and employment opportunities. There is a real desire from industry looking to decarbonise their energy, but this requires Government intervention.

For hydrogen produced by renewable energy, the UK's current carbon price structure and taxation system does not reflect the true cost of carbon dioxide emissions on the climate. Countries such as Sweden have imposed Carbon Prices of 110 euros per tonne whilst the UK's target is only £80 per tonne of carbon dioxide.

If the right infrastructure is in place, then renewable energy could generate green hydrogen at around 8p-15p per kWh which would be cost competitive against fuel, oil, coal and other fossil fuels for heating. **For renewable hydrogen to expand in the UK, a technology neutral approach is required.** The Government's green gas levy is an example of how this can create a level playing field to take away the implicit fossil fuel subsidy in the UK's energy system without raising production costs.

## Decarbonising industrial heat

Hydrogen can play an important role in industry which processes heat, including businesses operating in cement and glass industries. Whilst electrification will not be suited to all applications, hydrogen is a complementary approach for tackling industrial heating.

The HyLaddie project is a collaboration between Bruichladdich Distillery, Protium and ITP Energised. Bruichladdich is located on the southwestern tip of the remote Hebridean island of Islay, produces four unique spirits with locally grown barley and distributes its products globally. In April 2019, Bruichladdich announced its intention to run all operations on renewable energy with a goal for 100% decarbonisation by 2025.

The distillery's operations are highly energy intensive and require significant amounts of hot water and steam. Steam is currently generated by an industrial-sized boiler that uses medium fuel oil, and since there is no natural gas connection to the island, the boiler runs off medium fuel. Because of this, Bruichladdich, alongside other distillers on Islay, are part of the reason why Islay has the highest carbon dioxide emissions per capita in the UK. The HyLaddie project aims to change this by replacing the distilleries use of medium fuel oil with green hydrogen while using hydrogen combustion technology to deliver zero emission steam to the distillery. This project represents a world leading opportunity for the UK to show how green hydrogen can play a key role in decarbonising industrial heat.

# case study

# National Grid

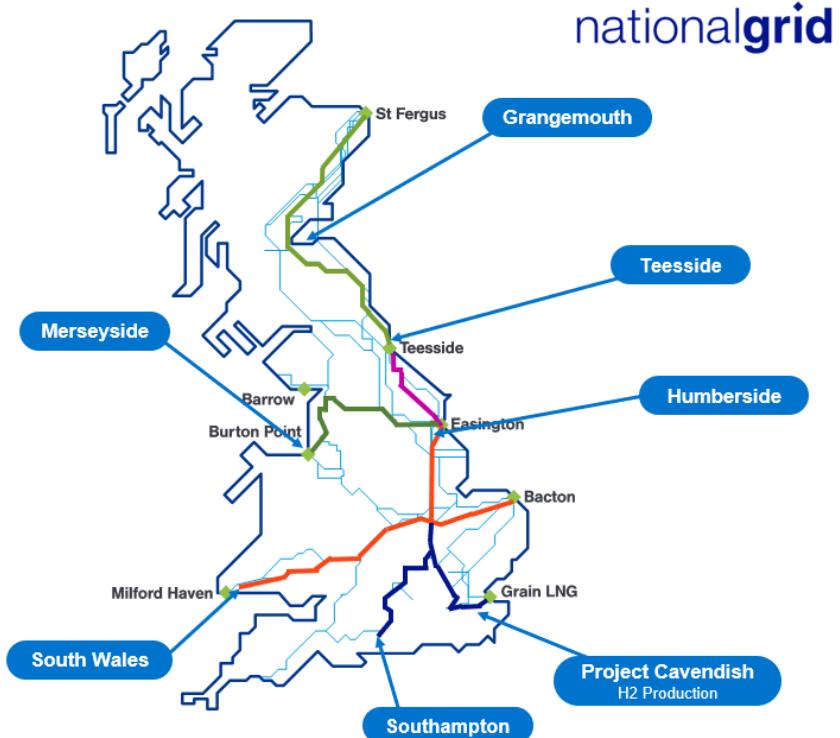
HyNTS

## Developing a UK hydrogen backbone

HyNTS  
ProjectUnion

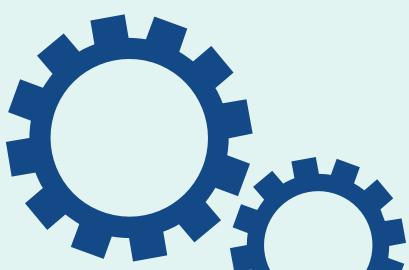
Project Union will review the potential phased repurposing of NTS pipelines to carry hydrogen and provide a hydrogen transmission 'backbone' for the UK

- Teesside – St Fergus
- Humber – Teesside
- Humber – Merseyside
- South Wales – Bacton – Humber
- Southampton- Cavendish



National Grid look to repurpose the existing gas transmission system to hydrogen

National Grid's project to explore the development of a UK hydrogen 'backbone' which aims to join industrial clusters around the country, potentially creating a 2000km hydrogen network. This would repurpose around 25% of the current gas transmission pipelines. The backbone could carry at least a quarter of the gas demand in Great Britain today. The project is using net zero development funding for the feasibility phase which will include identifying pipeline routes, assessing the readiness of existing gas assets, and determining a transition plan for assets. The research will explore how National Grid can start to convert pipelines in a phased approach from 2026.





# Hydrogen in the chemical industry and steel production

## Steel

For many applications there are limited alternative choices to deliver low carbon solutions, particularly those for high heat industrial requirements such as steel production and chemical processing.

Approximately 70% of global steel is produced by blast furnaces which produce more carbon emissions than steel, with roughly 1.3 tonnes of carbon dioxide released into the atmosphere for every tonne of steel. Mitsubishi Heavy Industries Group highlights that utilizing hydrogen in steel production could reduce the UK's steel industries carbon dioxide emissions to almost zero. Hydrogen used in the direct reduction of iron could eliminate the need for blast furnace equipment with its substitution by electric steelmaking. Green steel has the opportunity to become the lifeblood of the UK steel sector.

Exciting initiatives are already underway in decarbonising steel such as those in the South Wales Industrial Cluster, which is working alongside Milford Haven Port Authority to provide renewable steel. Marine Energy Wales highlights that 32,000 people are directly employed to support the steel industry in Wales and Yorkshire and the Humber, as well as over 40,000 more jobs in the wider supply chain. The skills and expertise for the emerging offshore energy industry as well as green hydrogen will be vital for helping to transition jobs from hydrocarbon sectors to clean technologies.

## Chemical processing

The Chemical Industries Association (CIA) recognises that hydrogen can play a pivotal role in eliminating the carbon footprint of energy in the chemical sector. A reliable and competitively priced hydrogen network in the UK would help to enhance the competitiveness of UK industry and would attract inward investment.

The chemical industry is already a significant participant in the hydrogen economy, being both a producer and consumer of hydrogen. Grey hydrogen is already used in the chemical industry, and this can be readily converted to be decarbonised to either blue or green hydrogen. The industry has the potential to drive forward hydrogen demand in the UK. The CIA also highlights their use of producing ammonia which can be used to store and transport hydrogen or create a clear hydrogen rich fuel in its own right.

The chemical industry has hydrogen available today to develop but will need support in getting this off the ground. Support for hydrogen in other sectors such as heating homes and decarbonising transport will also help to boost overall demand for the fuel, allowing markets to ramp up production and bring down the cost of supply. **This can be supported by the Government amending the Gas Safety Management Regulations to allow for hydrogen injection in the domestic grid.**

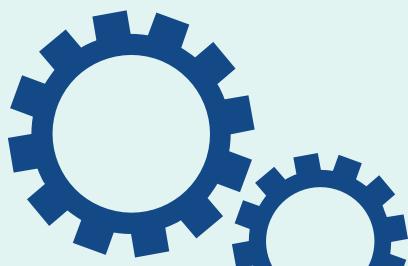
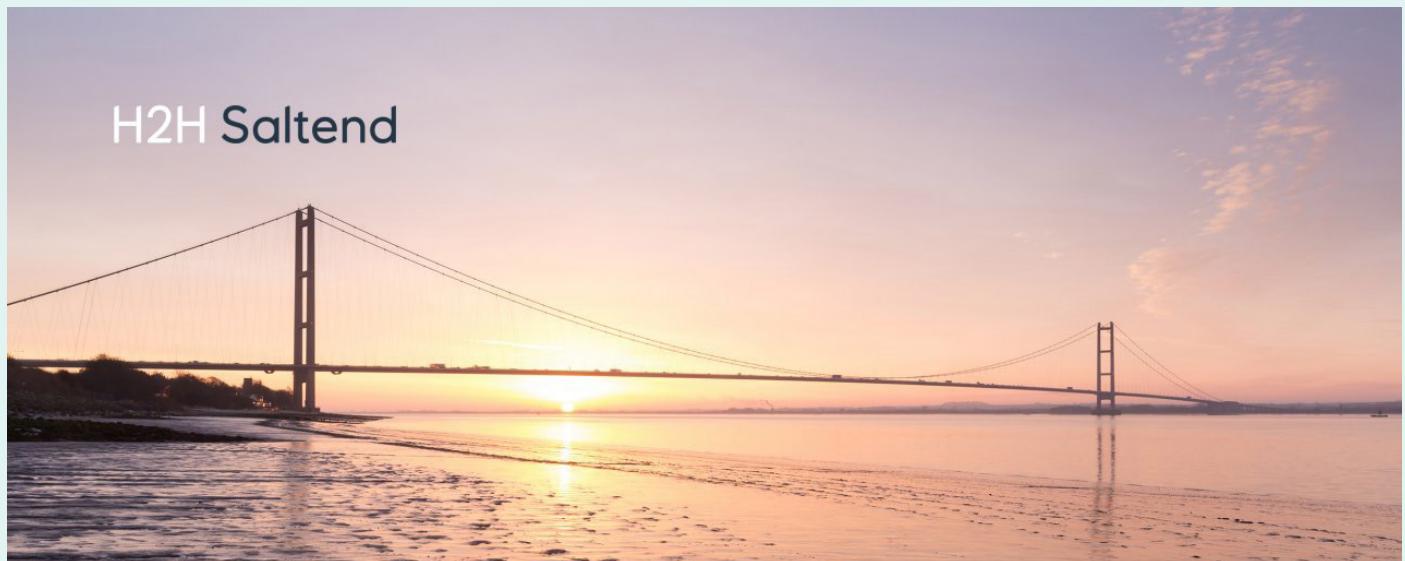
## case study

# Equinor

Equinor is leading a project to develop one of the UK's – and the world's – first at-scale facilities to produce hydrogen from natural gas, in combination with carbon capture and storage (CCS). The project, called Hydrogen to Humber Saltend (H2H Saltend), provides the beginnings of a decarbonised industrial cluster in the Humber region, the UK's largest by emissions.

H2H Saltend supports the UK Government's aim to establish at least one low-carbon industrial cluster by 2030 and the world's first net-zero cluster by 2040. It also paves the way for the vision set out by the Zero Carbon Humber alliance, which Equinor and its partners launched in 2019.

The project will be located at Saltend Chemicals Park near the city of Hull, and its initial phase comprises a 600 megawatt auto thermal reformer (ATR) with carbon capture, the largest plant of its kind in the world, to convert natural gas to hydrogen. It will enable industrial customers in the Park to fully switch over to hydrogen, and the power plant in the Park to move to a 30% hydrogen to natural gas blend. As a result, emissions from Saltend Chemicals Park will reduce by nearly 900,000 tonnes of CO<sub>2</sub> per year.



# The role of industrial clusters in powering industry

The industrial clusters identified by the Government as '*Super Places*' will play a significant role in facilitating the early development and deployment of hydrogen technologies, helping to catalyse the UK's hydrogen economy and wider supply chain.

The scaled use of hydrogen at industrial clusters is likely to be one of the first and major users of hydrogen. Many energy-intensive industries are located in industrial clusters where shared infrastructure can quickly benefit from large economies of scale. Using CCUS will help to address carbon dioxide emissions from several sources in industrial clusters, and enable the production of hydrogen which can be distributed to a number of industrial users operating within the cluster. The co-deployment of CCUS and hydrogen can provide one of the most cost-effective pathways to decarbonise the UK's most energy intensive industries.

The HyNet industrial cluster is working with over 30 industrial users with an interest in using hydrogen to reduce the carbon intensity of their processes. Several existing facilities across the UK produce hydrogen or hydrogen-rich fuels as a by-product and can use this fuel onsite. The Hy4Heat programme has also demonstrated that many applications will be commercially ready for deployment during the early 2020s with boilers, indirect users, heaters, kilns and many furnaces that will all be able to be deployed between 2023-2025. In addition to this, the third phase of the BEIS Fuel Switching Programme also hopes to demonstrate the necessary use of these applications to expedite deployment. The HyNet industrial cluster plans to deliver blends of hydrogen and natural gas to around 2 million households as well as commercial and industrial users with potential to further expand in the area.

To support the aim of decarbonising industry, blending of hydrogen will be required in the short-term. Blending hydrogen into the gas network provides an immediate means to reduce the carbon intensity of gas without requiring users to make changes. The HyDeploy project is demonstrating that levels of 20% by blended hydrogen can be achieved in the gas distribution network without requiring changes to appliances. This is further supported by National Grid who is also commencing the work on assessing the feasibility of blending into the transmission network. Blending will only be a temporary step towards decarbonisation on its journey to 100% hydrogen, however enabling blended hydrogen in the short-term will give confidence to producers that there will be demand and will enable early bulk hydrogen production, developing hydrogen infrastructure and buildings associated supply chains. For the Government to support the delivery of net zero, particularly in industrial clusters, a regulatory regime would need to be established that supports blending and allows retailers to sell additional green gas.

The Zero Carbon Humber initiative also involves converting three large scale gas turbines at Triton's Saltend Power Station to burn up to 30% of hydrogen in the first instance. Other projects underway include bioenergy and CCSU pilot project at Drax Power Station, which could deliver 16 million tonnes of negative emissions a year.

## case study

# Northern Gas Networks: H21

H21 is a pioneering hydrogen research and demonstration programme supporting conversion of the UK gas networks to carry 100% hydrogen.

Led by Northern Gas Networks, in partnership with Cadent, National Grid Gas Transmission, SGN and Wales & West Utilities, H21 began in 2016 as a feasibility study.



Based on a city the same size as Leeds, this proved that conversion of the networks was technically possible and financially viable. Four years later, H21 is establishing the critical safety evidence proving that a hydrogen gas distribution network is equally as safe as the natural gas network heating UK homes today.

**Phase 1:** H21 received £9 million of Ofgem Network Innovation funding in 2018 for the first phase assessing the suitability of the network to carry hydrogen. We have since developed facilities at DNV GL's base at Spadeadam, Cumbria and the HSE's site at Buxton to undertake asset testing.

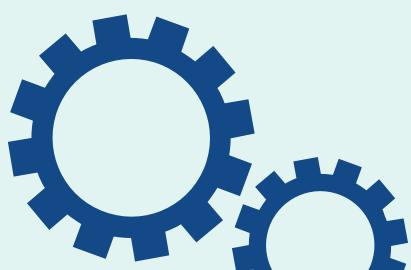
We have also delivered a social sciences workstream, led by Leeds Beckett University, to understand public perceptions of hydrogen and awareness of its use as an energy source. This study found that customers were generally supportive of converting gas networks to hydrogen. A full report for Phase One will be released in summer 2020.

**Phase 2:** An additional £6.8 million of NIC funding was granted for H21 Phase Two, to further develop the evidence base.

This work will focus on simulating network operations and involve testing at an unoccupied (decommissioned) section of the gas network, an essential prerequisite to live trials. One of the key outputs of Phase 2 is the development of the Quantitative Risk Assessment which will bring together findings from Phase 1 as well as the Hy4Heat programme, exploring hydrogen's use in buildings and appliances.

Further social sciences research will focus on developing communications resources to enable consumers to make informed choices on their future energy.

**Phase 3:** Following Phases 1 and 2 and enabled by the Quantitative Risk Assessment delivered through Phase 2, Phase 3 will deliver a 100% live trial to approximately 670 customers. We are currently developing a more detailed scope for this project but are targeting commencement of the trial by mid-2022.





# Creating jobs through powering hydrogen and industry

Hydrogen has the potential to create and protect existing jobs in the UK whilst supporting the UK's economic recovery. The ECITB recognises that the construction of new hydrogen production with CCSU planned at H2H Saltend as part of the Humber Cluster Plan will support 24,000 jobs during the construction phase, and approximately 23,600 longer-term jobs in the wider supply chain and economy. Similar opportunities will also arise at other industrial clusters across the UK. Zero Carbon Humber expects to protect 55,000 existing jobs and create 49,000 new ones while supporting skills, apprenticeships and education opportunities in the region.

The development of hydrogen projects across the UK will support jobs in specific sectors such as those in the engineering design industry. There is significant expertise in engineering design in the UK and due to the falling oil price levels, there has been a significant downturn in engineering design work. UK-based hydrogen projects can provide an opportunity to revive this sector and provides the opportunity for transferable skills to be implemented.

As recognised by the Hydrogen Taskforce and CBI, a commitment to hydrogen by the Government could create over 75,000 jobs and generate up to £18 billion of GVA for the UK each year by 2035. Enabling a multitude of technologies, including supporting nuclear energy, will support overall innovation and help deliver this target.

There is also huge potential to create new green jobs through hydrogen production in the UK. Production of hydrogen within the UK as opposed to importing will be key in creating and sustaining green jobs across the UK, whilst maximising supply chain opportunities and supporting the Government's levelling up ambitions.

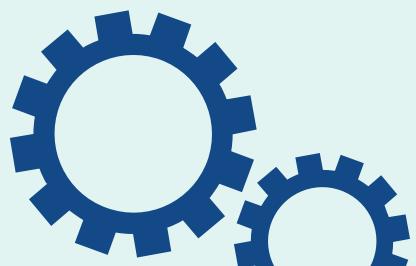
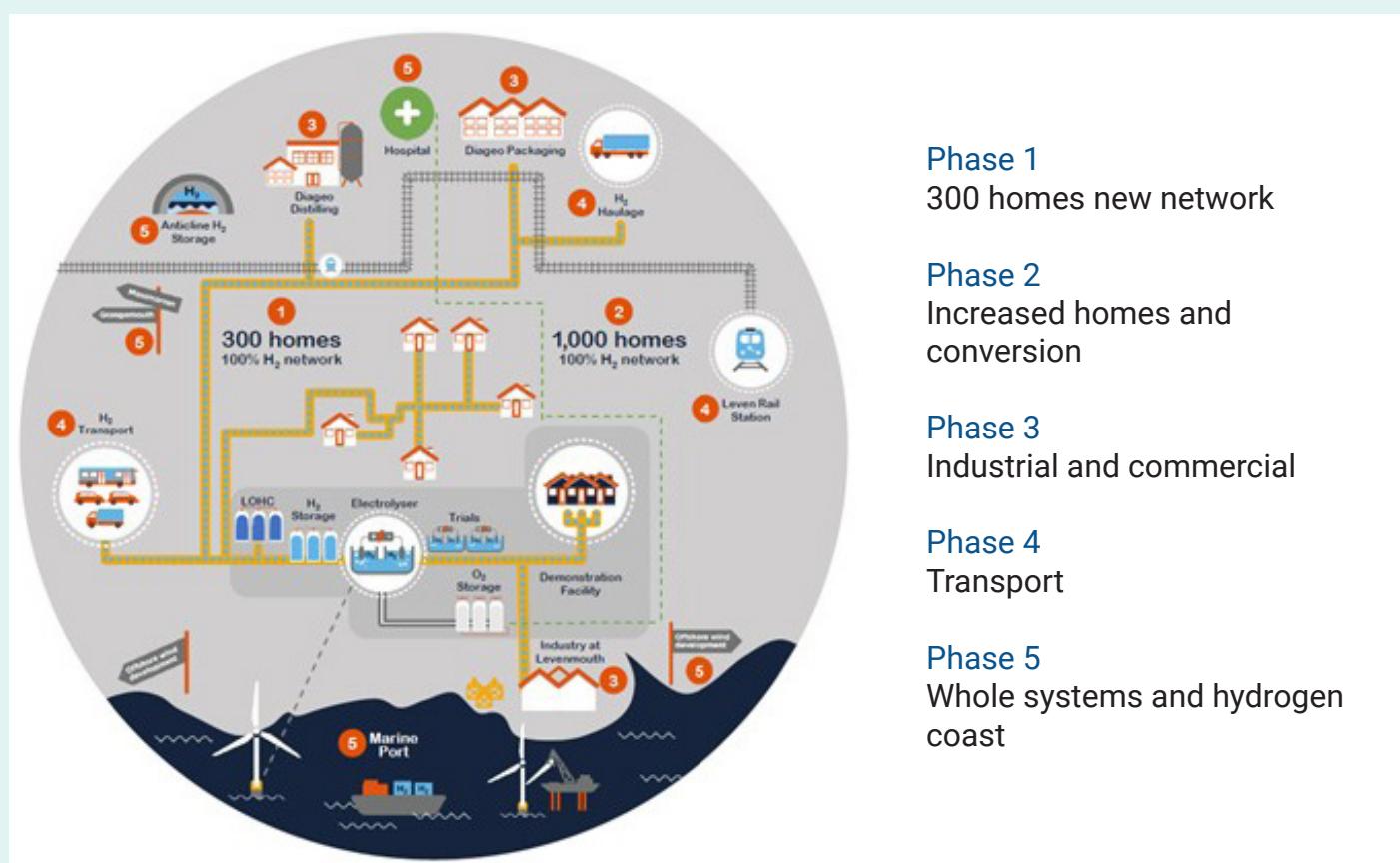
## case study

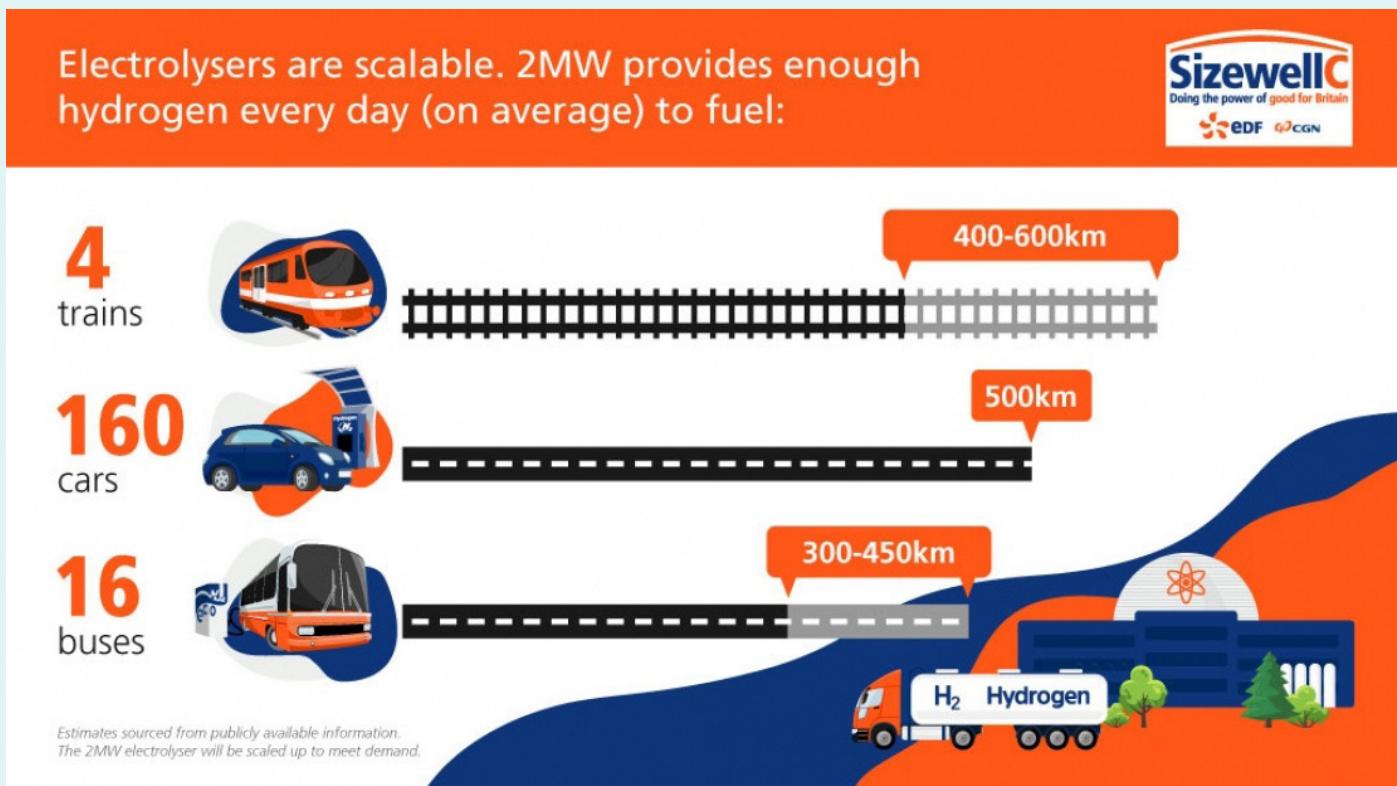
# SGN: H100 Fife

Gas distribution network SGN are leading a pioneering project in Levenmouth, Scotland, called H100 Fife. For the first time anywhere in the world, the project will supply households with 100% green hydrogen for heating as well as seeking to prove the integration of offshore wind innovation, placing Fife at the forefront of the global clean energy revolution.

As well as providing technical evidence, the project will validate customers' interest in and acceptance of hydrogen applications and assess the performance of hydrogen as a replacement for natural gas in homes. Phase one of H100 Fife will connect 300 homes (on an opt-in basis) to a new 100% hydrogen network. A demonstration facility which will be completed next year, will allow customers to see and experience hydrogen appliances in a home-like setting prior to opting in. Customers will then begin to be connected from the new hydrogen network from the end of 2022.

Phase two of the project aims to expand the number of customers receiving a hydrogen supply and scaling up to create the UK's first hydrogen town by the end of the decade, as envisaged in the Government's Ten Point Plan for a Green Industrial Revolution. Further phases going into will bring opportunities to decarbonise industry and transport in the surrounding area.





Nuclear and hydrogen are two clean technologies that can help us make big reductions in carbon emissions. Nuclear generates always-on low carbon power and for years has provided around 20% of the UK's electricity. Hydrogen only produces water when it burns and has great potential as a clean fuel for transport, industry, and home heating.

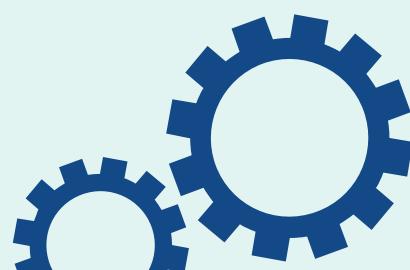
Nuclear and hydrogen are both big priorities for the Government. They were included in the Ten Point Plan for a Green Industrial Revolution and the 2020 Energy White Paper.

While both technologies are vital on their own, at Sizewell C we have an exciting vision to bring them together.

One of the best ways of producing hydrogen is by splitting water molecules using an electrolyser. Using low carbon nuclear energy to power the electrolyser means we can produce so-called green hydrogen which has no carbon emissions.

At Sizewell C, we are exploring how we can produce and use hydrogen in several ways. Firstly, it could help lower emissions during construction of the power station. Secondly, once Sizewell C is operational, we hope to use some of the heat it generates (alongside electricity) to produce hydrogen more efficiently.

Sizewell C is launching a demonstrator project to produce hydrogen powered by electricity from neighbouring Sizewell B. Initially, a 2MW electrolyser could potentially produce up to 800kg of hydrogen per day (or c. 290,000 kgs per year). This will be scaled up to meet demand.



# Contributions

The APPG would like to thank the below organisations for their contributions in evidence.

AFC Energy PLC	Mitsubishi Heavy Industries
Alstom UK	National Grid
Anglo American	National Nuclear Laboratory
Arup Advisory	North of England Hydrogen Forum
Baglan Bay Innovation Centre	Nuclear Industry Association
Baxi	NWNA
Bosch	OGUK
British Geological Survey	ORE Catapult
Cadent	Orsted
Carbon Capture & Storage Association	Pale Blue Dot
Carbon Engineering	Porterbrook
Ceres Power	Powerhouse Energy
Chemical Industries Association (CIA)	Progressive Energy
Costain	Protium
e3g	Repsol Sinopec Resources UK
EDF	RWE
Engineering Construction Industry Training Board	S&P Global
Equinor	School of Geosciences, University of Edinburgh
ERM	Scottish Enterprise
EUA	Scottish Hydrogen and Fuel Cell Association
EWE	Scottish Power
Glass Futures	Shetland Islands Council
Green Alliance	Sister Smith
Highlands and Islands Enterprise	Sizewell C
Hydrogen Accelerator	South of Scotland Enterprise
Hydrogen Taskforce	SSE
Hydrologiq	Star Refrigeration Ltd
Institution of Engineering and Technology (IET)	Thornton Energy Research Institute, University of Chester
Johnson Matthey	TP Group
JouleVert Limited	TÜV SÜD National Engineering Laboratory
Last Mile	UK HFCA
Logan Energy Limited	UKPIA
Low Emission and Hydrogen Mobilisation Ltd (LEH2M)	University of Edinburgh
Marine Energy Wales	University of Leeds
Maywood & Partners	University of Warwick
MCS Charitable Foundation	UNISON
Milford Haven Energy Kingdom Project	Westinghouse Electric Company

# About the APPG

The APPG on Hydrogen provides a forum for MPs and Peers to engage with leading businesses and organisations that are working to enable the UK to meet its decarbonisation targets through the implementation of hydrogen projects, and to discuss policy options to support these.

The Group was established in July 2018. It is a cross-party group of MPs and Peers that focuses on raising awareness of, and building support for large scale hydrogen projects – such as conversion to a hydrogen domestic gas grid – that will enable the UK to meet decarbonisation targets.

## Contact the group



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[connectpa.co.uk/appg-hydrogen/](http://connectpa.co.uk/appg-hydrogen/)



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