A hydrogen vision for the UK

How the evolution of a UK-wide hydrogen network can unlock economic growth, provide consumer choice and bolster energy security

April 2023

The voice of the networks

Contributing Partners

Foreword

Lawrence Slade FEI
Chief Executive
Energy Networks Association

Energy touches every part of our economy – and we are on the brink of a major transformation in how we both produce and use it.

Over the next 27 years all homes, businesses and industries must move away from the unabated fossil fuels that currently meet most of our energy demands to clean alternatives like renewables, nuclear and hydrogen.

This transition to clean energy will require significant change. Some of these changes, like building new offshore wind farms, may go unnoticed by consumers. Other changes will require us to adjust our behaviour; for example, shifting to electric vehicles, replacing industrial fossil fuel equipment and exchanging the natural gas boilers that heat our homes and businesses today for low carbon alternatives. The scale and pace of this change will eclipse anything seen in the sector before.

We will need a range of low carbon technologies to decarbonise our energy system. Hydrogen could play a critical part of this story, projected to provide between 20-35% of our energy demand by 2050,[1] delivering our climate and security goals in a way that ensures the energy we need is affordable. This means a need for renewables, nuclear, biofuels and energy efficiency, as well as other emerging technologies such as carbon capture and storage and batteries. But without hydrogen in the mix, there can be no Net Zero.

Building our greener future will require innovation, investment and rapid infrastructure development. Yet against such challenge, there is opportunity. A clean energy system with energy security and affordability at its heart will benefit companies, communities and consumers alike. With the right commitment to change, and the right policy and regulatory framework in place, we can use this transformation to deliver economic growth, jobs and a cleaner, greener world that will be good for the UK today and for the generations that follow tomorrow.

It will need new infrastructure. We will need to repurpose today's pipes to safely and reliably move the hydrogen we need around. We will also need new facilities to store hydrogen between when it is produced in summer to when it is needed in winter. And we will also need new appliances in industry, business and homes to turn the hydrogen into useable energy. The gas networks in GB and Northern Ireland are committed to playing a leading role in delivering this. GB network operators stand ready to invest £6.8bn[2] by the end of the decade in hydrogen-focused projects, whilst delivering on the core role of safely and reliably moving energy around the country from where it is produced to where it is used.

This report is a vision for how to do just that, showing how the infrastructure we have today can evolve from one based on the supply of fossil fuels to one providing the backbone of a clean hydrogen system.

This decade is critical; we must move from talking about change to delivering it. The ambitious government hydrogen targets across the UK will only be met with clarity, focus and partnership. The gas networks are ready to play their part in the UK's energy future. They have a plan, know what is needed to deliver it and are taking the necessary steps to do just that.

Lawrence Slade FEI
Chief Executive

1. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf
2. https://www.energynetworks.org/industry-hub/resource-library/gas-goes-green-innovation-impacts.pdf

Our five pledges

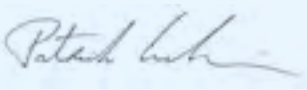
1. Play a lead role in delivering against the UK's hydrogen ambitions

2. Conduct further research and testing in an open and transparent manner

3. Engag consume across ou network deliverin Net Zero

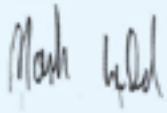
Steve Fraser
Chief Executive Officer
Cadent Gas

Paddy Larkin
Chief Executive Officer
Mutual Energy



Jon Butterworth
Chief Executive Officer
National Gas

Mark Wild OBE
Chief Executive Officer
SGN



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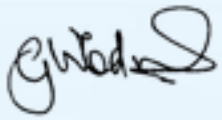
4. Work collaboratively with all stakeholders across the sector using a 'whole systems' approach

5. Invest in both developing a skilled workforce for the future and a UK supply chain

Mark Horsley
Chief Executive Officer
Northern Gas Networks

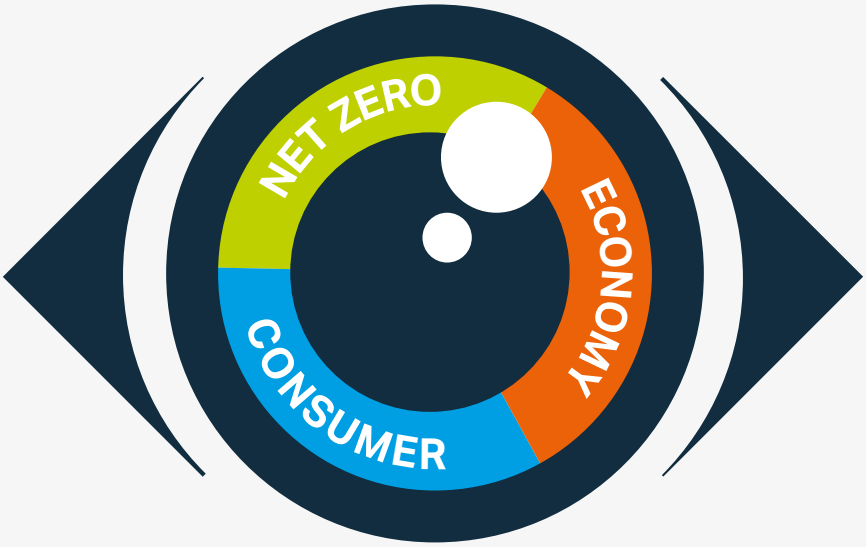
Graham Edwards OBE
Chief Executive Officer
Wales & West Utilities



More detail on these pledges can be found on p.25 ▸

A hydrogen vision for the future

Our shared vision is one where hydrogen will have a crucial role to play, alongside other technologies, in the energy system of the future. It will offer consumers choice when it comes to decarbonisation and can deliver significant economic value for communities across the UK.



Consumer
Delivering for the wants and needs of consumers, whether they be industrial, commercial or residential; complementing other technologies by offering a decarbonisation route which may be cheaper and less disruptive for some.

Net Zero
Transforming our network to deliver Net Zero energy for the UK, tackling climate change and improving air quality.

Economy
Supporting a just transition to clean energy with jobs, economic value and energy security; growing the UK's domestic hydrogen economy whilst delivering wider benefits to communities across the country.

Hydrogen is essential for Net Zero

Today, in 2023, the UK (and the world) is largely dependent on fossil fuels – for power, transport, industrial processes and our food system, as well as for heating homes, businesses and public sector buildings like schools and hospitals.

Politicians and the public are united in the ambition to achieve Net Zero by 2050, though the precise path to reach this is not yet known. Whilst we may not be able to say how much of each low carbon technology we will need, it is clear that hydrogen is an essential part of the future low carbon energy system in 2050, here in the UK and across the world. Put simply, without hydrogen, there will be no Net Zero.

"Our analysis has demonstrated multiple pathways to Net Zero in the UK. In all of them, it's clear we will need a lot of clean hydrogen."

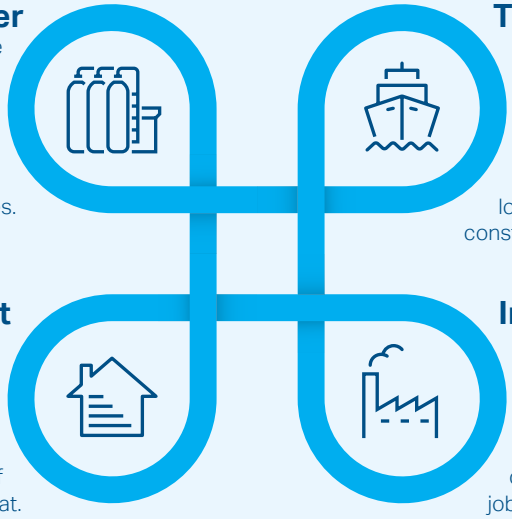
CHRIS STARK
CEO, CLIMATE CHANGE COMMITTEE (CCC)
EXTRACT FROM COMMENTS MADE BY CHRIS ON AN IGEM-HOSTED TOUR OF UK HYDROGEN PROJECTS

Power

Clean renewables will provide the backbone of our future electricity system. Clean sources of back-up power and energy storage will complement these assets to ensure the lights stay on when the sun isn't shining or the wind isn't blowing. Hydrogen will be one of these clean back-up sources.

Transport

Electric vehicles will be dominant in personal cars, van fleets and some trains and trucks, however hydrogen-powered vehicles will be required to fulfill heavy-duty transport needs, such as ships and planes. It will also be needed to fuel some lorries, coaches and longer bus routes, as well as emergency and construction vehicles, and agricultural machinery.



Domestic heat

Technologies like heat pumps and heat networks have a major role in decarbonising our heat and hot water, however hydrogen is likely to be the best solution for some consumers, depending on where they live, the characteristics of their home and how they use heat.

Industry

Many industries, including those that make the chemicals, steel and household goods we all rely on, will need the high temperature process heat that low carbon hydrogen will supply. This will be critical to decarbonising these industries and keeping jobs in the UK.

Hydrogen can get the best use out of our existing infrastructure

Gas networks are using the tools we are responsible for to deliver this vision for consumers. Without gas pipeline infrastructure, we risk increasing the cost of the transition to clean energy, forcing industry and businesses to relocate and undermining public support for Net Zero.

This is why the UK's gas networks have been working together on a plan for readying the existing networks to deliver Net Zero in the most cost-effective and least disruptive way possible - a blueprint through which our gas networks can meet the challenges and opportunities of climate change.

Hydrogen can offer a lower total cost of decarbonisation, provide choice and keep UK businesses competitive.

ENA work has already demonstrated a balanced decarbonisation solution that includes a significant role for hydrogen transformation, alongside biogases and electrification. There is good evidence to suggest that this balanced approach is the most cost-effective way to decarbonise, producing an estimated saving of around £13bn a year by 2050 in GB alone.[3]

A 2050 energy system with hydrogen will make use of the UK-wide underground pipe network built and paid for by consumers over decades - reducing the need for new, above ground infrastructure which could be disruptive for the communities that would live around it.

Thousands of businesses and industrial sites across the UK are looking for a low carbon gas to meet their carbon reduction requirements and remain economically competitive. Many companies are already working with gas networks today to introduce hydrogen into their manufacturing processes.

Other low carbon gases such as biomethane will also play important roles alongside hydrogen. We will be evaluating the interplay between hydrogen and biomethane in future work.

"Hydrogen transport and storage infrastructure will be a critical enabler to meet Government's ambition for 10 GW of hydrogen production by 2030."

JANE TOOGOOD
UK HYDROGEN CHAMPION
EXTRACT FROM HER MARCH 2023 REPORT *ACCELERATING THE GROWTH OF THE HYDROGEN SECTOR: UK HYDROGEN CHAMPION RECOMMENDATIONS*

3. ENA, Gas Decarbonisation Pathways, https://www.energynetworks.org/assets/images/Resource%20library/ENA%20Gas%20decarbonisation%20Pathways%202050%20FINAL.pdf

Hydrogen unlocks multiple benefits for the end consumer

Full UK decarbonisation

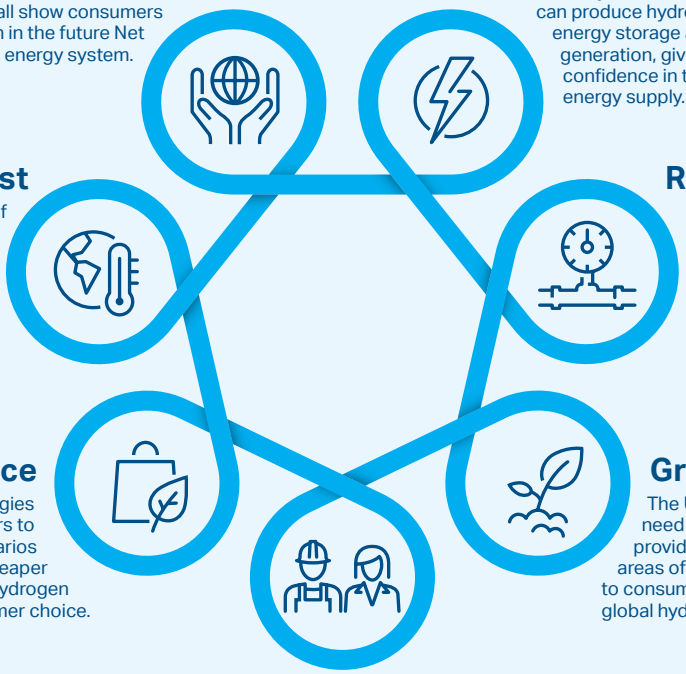
There will be no Net Zero without hydrogen. Modelling from UK Government, National Grid and the CCC all show consumers will need hydrogen in the future Net Zero energy system.

Increased energy security

Hydrogen can be produced, stored and used flexibly. Excess renewable energy can produce hydrogen, providing energy storage and back-up power generation, giving consumers confidence in the security of their energy supply.

Lower Net Zero cost

ENA analysis has shown that a mix of low carbon heating solutions could save consumers as much as £13bn a year by 2050 in the UK, compared to an all-electrification scenario.



Reliance and resilience

A diverse energy system is more resilient. Gas networks offer 99.999% supply reliability, with consumers experiencing unplanned supply interruptions, on average, only once in every 140 years.

Consumer choice

There are a range of technologies which can help consumers to decarbonise. There are scenarios where hydrogen may well be cheaper and less disruptive for some. Hydrogen enables consumer choice.

Growth opportunity

The UK hydrogen economy will need homegrown supply chains, providing new, skilled jobs and new areas of manufacturing that can export to consumers in a multi-trillion pound global hydrogen market.

Jobs and skills

Protecting and creating jobs in the gas sector and wider economy, with potential to create 221,000 jobs by 2050.[4]

4. ENA, Britain's Hydrogen Network Plan, https://www.energynetworks.org/industry-hub/resource-library/britains-hydrogen-network-plan.pdf

Hydrogen can be a unique UK economic growth story

Through engagement with consumers across our networks, it has become increasingly clear that moving hydrogen through the gas network is not just required for decarbonisation and cost-effectiveness but is a major opportunity for growing the UK economy and delivering a just transition to clean energy.

The gas networks in GB alone stand ready to invest £6.8bn in hydrogen-focused projects by 2031/32.[5] Hydrogen UK estimates investment in the wider hydrogen supply chain could deliver £18bn economic value and create 75,000 jobs,[6] and specifically, within the gas networks, investment is expected to deliver 13,337 jobs (a 33% increase on the current 40,000 strong workforce), with a further 11,486 created in the wider supply chain by 2031/32.

Through this investment, and further action up to 2050, the gas networks will be the backbone of the UK hydrogen economy:

- Providing clean fuel with low or no carbon emissions to key industries, manufacturers, ports, schools, hospitals and agriculture.
- Protecting and creating jobs in the gas sector and wider economy, with potential to create 221,000 jobs by 2050.[7]
- Boosting export potential for UK hydrogen companies to sell into a future multi-trillion pound market.

Maximising opportunities for economic growth, energy security, and supporting cost-effective consumer bills and decarbonisation will require a joint-endeavour between industry and the Government.

As the maps in this report illustrate, the gas networks will invest to ensure we are ready for whatever role is required of us. However, this will require policy and political signals from Westminster, as well as local government, in order to continue to progress at pace.

"Hydrogen presents a significant economic opportunity for the UK and could transform our North Sea energy industry and industrial heartlands."

CHRIS SKIDMORE
CHAIR OF THE INDEPENDENT GOVERNMENT REVIEW ON NET ZERO
EXTRACT FROM THE MISSION ZERO: INDEPENDENT REVIEW OF NET ZERO

The joint endeavor

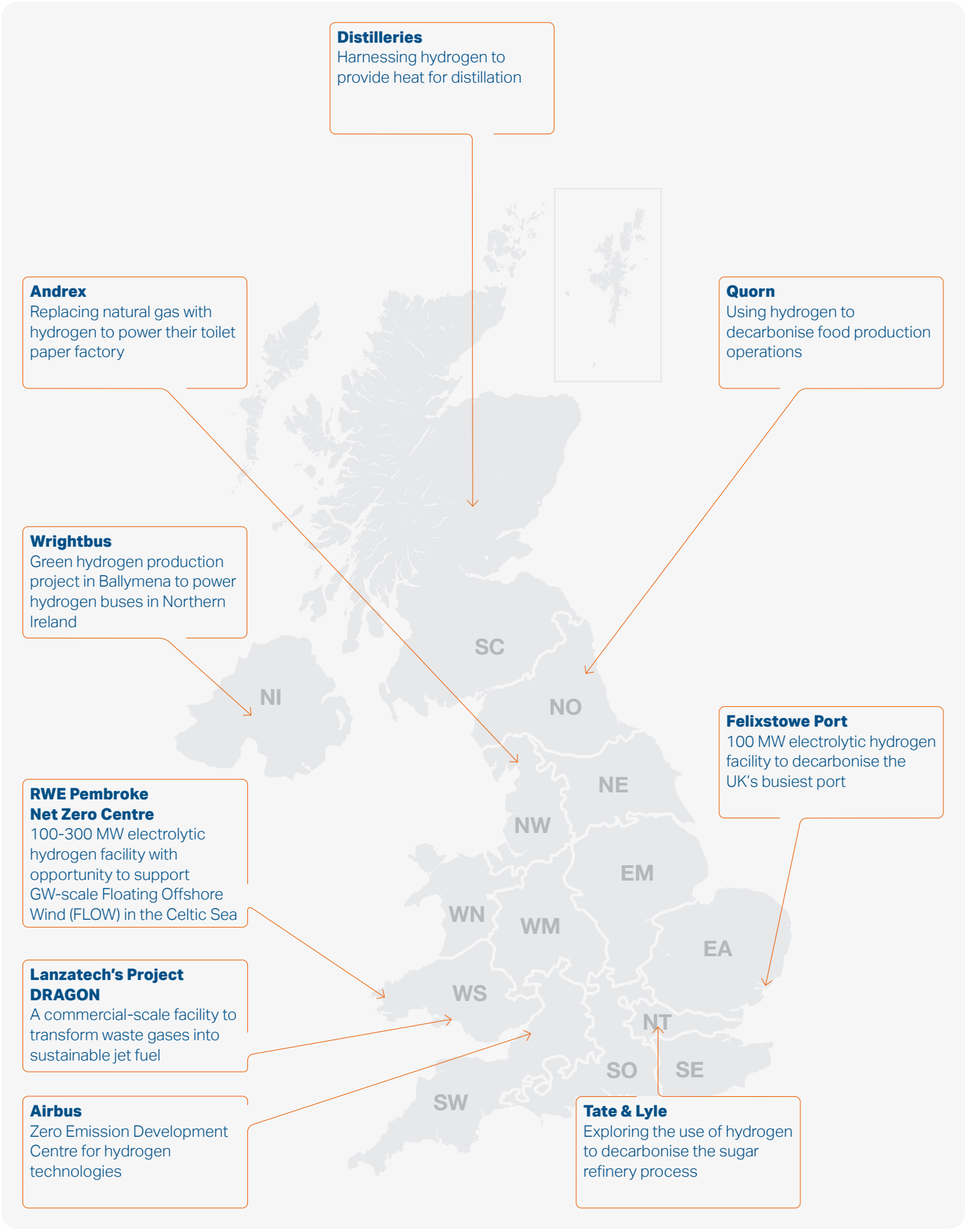
Government
Will set the strategy and frameworks to unlock investment

Industry
Will provide the capital and delivery expertise

Outcome

Maximum benefits to UK economic growth and cost-effective consumer bills

5. ENA, Net Zero Innovation Impacts, https://www.energynetworks.org/industry-hub/resource-library/gas-goes-green-innovation-impacts.pdf
6. Economic Impact Assessment, Hydrogen Taskforce, Economic value number is gross value added.
7. ENA, Britain's Hydrogen Network Plan, https://www.energynetworks.org/industry-hub/resource-library/britains-hydrogen-network-plan.pdf


Distilleries
Harnessing hydrogen to provide heat for distillation
Andrex
Replacing natural gas with hydrogen to power their toilet paper factory
Quorn
Using hydrogen to decarbonise food production operations
Wrightbus
Green hydrogen production project in Ballymena to power hydrogen buses in Northern Ireland
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Felixstowe Port
100 MW electrolytic hydrogen facility to decarbonise the UK's busiest port
RWE Pembroke Net Zero Centre
100-300 MW electrolytic hydrogen facility with opportunity to support GW-scale Floating Offshore Wind (FLOW) in the Celtic Sea
Lanzatech's Project DRAGON
A commercial-scale facility to transform waste gases into sustainable jet fuel
Airbus
Zero Emission Development Centre for hydrogen technologies
Tate & Lyle
Exploring the use of hydrogen to decarbonise the sugar refinery process

Mapping out the potential

The UK's gas network consists of over 280,000 km of pipes; enough to travel around the world seven times. Around 75% of the gas distribution pipelines have been replaced under the Iron Mains Risk Reduction Programme – a scheme which will see a total investment of £28bn.[8] As a result, the gas networks already stand in a strong position to transition to new, low carbon gases.

New policy announcements are accelerating the development of the hydrogen economy in order to increase system resilience, and prepare for rapid scale up in the 2030s in line with the Hydrogen Strategy and Sixth Carbon Budget.

Government targets for offshore wind will see a huge increase in fixed and floating offshore wind around our coasts. There will be times when the electricity generated from our wind resources outstrips demand. Wind developers understand that green hydrogen production is an opportunity to avoid curtailment, which cost UK consumers over £500m in 2022 from onshore windfarms alone. This is why SGN is conducting a study to assess the potential volume of green hydrogen production in Scotland from existing curtailed renewable energy developments and from planned assets.

Similarly, developers of new nuclear – at gigawatt and small modular scale – are exploring how to integrate hydrogen into their sites, where heat from nuclear plants offers high efficiency production. As Mission Zero stated: "nuclear stations also produce very large volumes of low cost, low carbon heat. Historically this heat has not been utilised in the UK. But in the Net Zero context, there are a range of future opportunities to take advantage of it, through for example improving the efficiency of hydrogen production".[9] As a result, the Government's commitment to scale up the UK's nuclear fleet provides additional opportunity for hydrogen production.

Due to the extensive capacity of the UK's gas networks, greater levels of investment into new renewable projects could be unlocked if producers have access to pipelines to carry their hydrogen to a consumer. As a result, networks are commonly seen as enabling partners in new energy and industrial decarbonisation projects across the UK.

For the first time, Britain's gas networks have come together, alongside Mutual Energy from Northern Ireland, to show the opportunity to develop a UK-wide hydrogen economy between 2030 and 2050.

We have developed a series of maps, outlined in subsequent pages of this report, depicting a plausible vision for the rollout of hydrogen and the infrastructure to support it. In 5-year increments, the maps show what a gradual shift to a hydrogen-based network could look like. They show where pipes are being repurposed to keep transition costs down for consumers, supported by strategic new build infrastructure.

These maps are rooted in robust modelling, completed in 2021, which we've collaborated with the UK Government to develop. This is known as the Common Future End States (or "CFES") modelling. The scenario reflected in these maps is the "H5" scenario from this modelling, which is an ambitious yet realistic scenario for the role hydrogen could play in the energy system of the future. We have collaborated with Mutual Energy in Northern Ireland to supplement this modelling with plausible estimates for the rollout of hydrogen in Northern Ireland as well.[10]

The maps are based on:

- 354 TWh of hydrogen in the 2050 energy system, which is approximately half of current UK natural gas demand for heating and is broadly aligned with projected demand in the Climate Change Committee's "Headwinds" and National Grid's "System Transformation" scenarios.
- 17m homes supplied by hydrogen and 14m by electric alternatives in 2050 (these figures also reflect housing stock growth in this period).
- 50 TWh of hydrogen storage delivered by 2050, which is roughly five times the current natural gas storage capacity in the UK.

8. Hydrogen UK, Hydrogen Networks, https://hydrogen-uk.org/wp-content/uploads/2023/02/HUK_Recommendations-for-the-Acceleration-of-Hydrogen-Networks_online-Jan23.pdf
9. Mission Zero, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128689/mission-zero-independent-review.pdf
10. Estimates for the percentage of connections to the hydrogen network in Northern Ireland have been extrapolated from data in a report produced by Guidehouse in 2021 for the five gas networks in Northern Ireland

Since 2021 there has been an increase in ambition from UK government in relation to hydrogen which we have sought to factor into the maps, using our knowledge of activity on the ground to reflect this in the maps. This includes:

Small scale green hydrogen projects across the country supported by the Renewable Transport Fuels Obligation, the £240m Net Zero Hydrogen Fund, and £90m Green Hydrogen Fund in Scotland

Large scale blue hydrogen production projects underway in the North West and North East enabled by the UK's first Carbon Capture Utilisation and Storage (CCUS) clusters

Preparations for a hydrogen village trial in either Redcar in Teesside or Whitby in the North West. The trial will see 100% hydrogen used in existing pipelines, and by existing residential and commercial consumers from 2025

The H100 Fife project in Scotland which will connect 300 homes to the UK's first 100% hydrogen network in 2025

Given the scale of the network both today and in future, the maps show only repurposed and new transmission pipelines. It is important to note that the distribution network transporting our gas under the streets and roads of our villages, towns and cities is also being repurposed where necessary to underpin this transition. This will happen alongside the work on the transmission network indicated on the maps.

As we deliver the hydrogen network indicated on the maps, the remainder of the network will continue to transport natural gas safely and reliably to those who rely on it. The volume of natural gas we use will decline over time as consumers convert to clean alternatives such as low carbon electricity and hydrogen. As a result, and as the maps show, by 2050 the volume of energy transported by the gas network transports will be significant, but less than today.

Alongside the maps of pipeline infrastructure, we have also indicated where we expect to see likely sites for hydrogen production, carbon capture and storage facilities, hydrogen storage and hydrogen used in a number of transport applications (aviation, rural trains and hydrogen refueling stations). Long term, there may well also be significant economic opportunity from hydrogen export, which we have indicated on the maps. Networks are engaging now with electrolytic and CCUS-enabled hydrogen production developers to assess their needs and ensure they are ready to play a supporting role in getting projects off the ground.

As the maps illustrate, the gas networks will enable nationwide production and use of hydrogen across the UK to:

- **Unlock the full range of economic benefits** it offers in each part of the country.
- **Provide choice, flexibility and resilience** to Government, local authorities, and consumers to assist in the development of their growth and decarbonisation strategies.

Full details of the data which underpins the maps can be found in the appendix.

Mapping out the potential

2030

ENERGY TARGETS

UK Government: 10 GW of low carbon hydrogen production (with at least 5 GW of this from electrolytic production)

Scottish Govt: 5 GW hydrogen production

50 GW offshore wind

Four CCUS Industrial Clusters

Hydrogen Town, following delivery of a Hydrogen Village

HOW WILL THE CONSUMER BENEFIT?

Hydrogen will be available for consumers in industrial clusters, with co-located supply and demand that will be supported by local dedicated [private] networks and storage

In these areas, businesses are able to benefit from 'first-mover' status in the pioneering of hydrogen-powered products

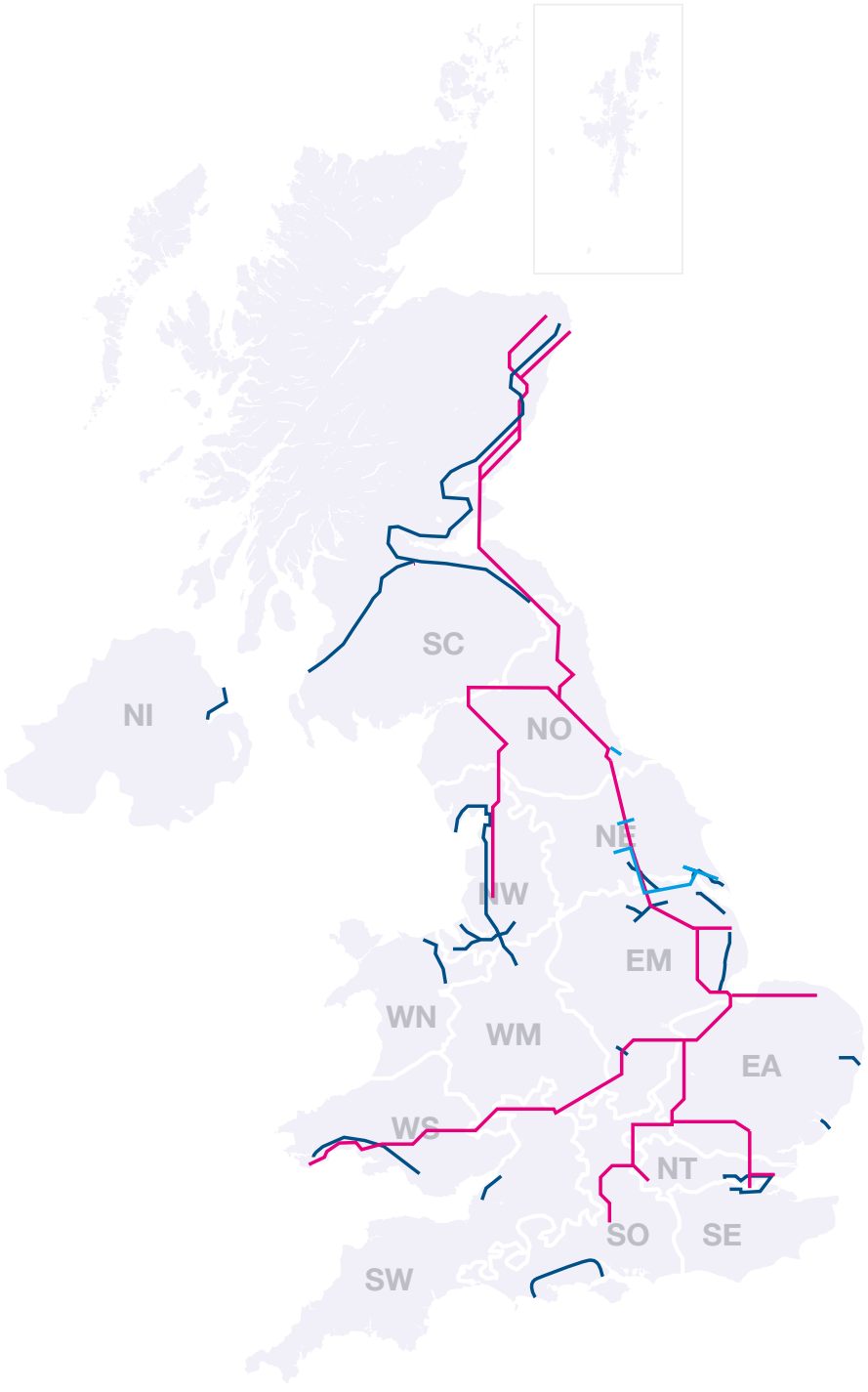
TECHNICAL DETAIL

Only a small number of natural gas connections have converted to hydrogen, largely industrial

Large parts of the national transmission system are converted to transport 100% hydrogen to early industrial fuel switchers and power generators. New and re-purposed sections of this network will deliver a hydrogen backbone infrastructure on a national level, linking hydrogen production with demand via downstream hydrogen ready gas networks

In Northern Ireland, a relatively small corridor of pipeline infrastructure can connect electrolysis production sites at potential offshore wind grid connection locations, current thermal power stations, salt cavern storage sites and the existing gas transmission system

Hydrogen storage in salt caverns and depleted oil and gas wells will come on stream in the early 2030s



Demand volumes are predicted and pipelines are a visual representation of potential geographic locations.

Pipeline developments

- New and repurposed National Transmission System pipes
- New and repurposed Local Transmission System pipes
- New third party pipes

Percentage of consumers using the hydrogen network

0-10 11-20 21-30
31-40 41-50 51-60
61-70 71-80

DEMAND

Early hydrogen demand driven by industrial clusters and Freeport development. Early residential and commercial demand around hydrogen Town projects starts

CARBON CAPTURE & STORAGE

The first facilities will be operational around Morecambe Bay, the North-East of England and near Aberdeen

BLUE HYDROGEN PRODUCTION

Industrial cluster demand underpins development of blue hydrogen production in places like Pembrokeshire, Ellesmere Port, the Humber, Bacton, Teesside and Scotland

GREEN HYDROGEN PRODUCTION

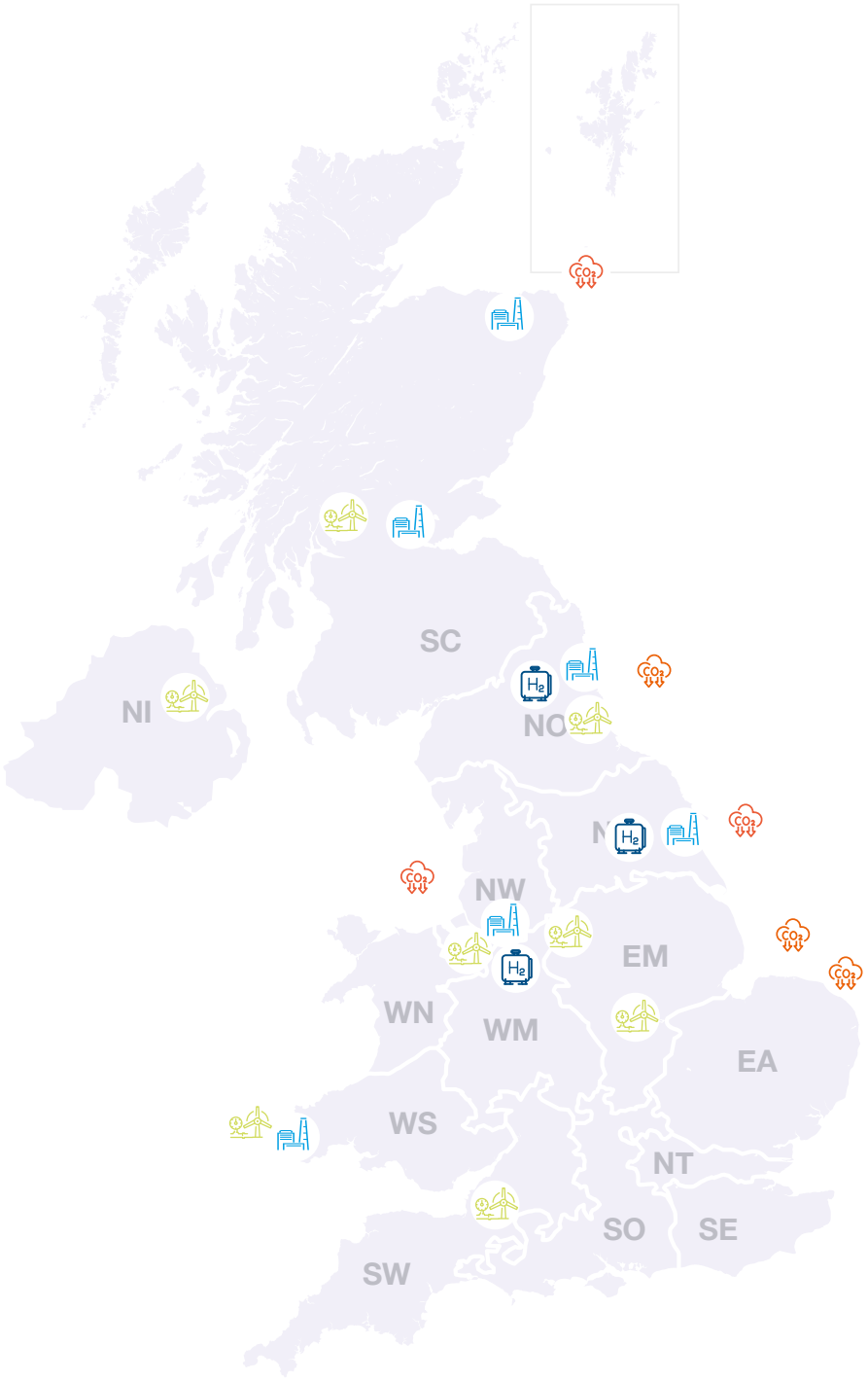
Efforts to decarbonise the power sector see increased green hydrogen production across the country

STORAGE

The first hydrogen storage facilities are operational, largely located near industrial clusters in the North-West, the Humber and Teesside

HYDROGEN FOR TRANSPORT

Airports such as Manchester, Liverpool and Bristol begin using hydrogen to decarbonise some operations. Transport hubs in places like Warrington emerge



- Carbon Capture and Storage
- Blue hydrogen production
- Green hydrogen production
- Pink hydrogen production
- Hydrogen storage
- Hydrogen refuelling station
- Trains running on hydrogen
- Airports using hydrogen as aviation fuel
- Hydrogen exports

Infrastructure is a visual representation of potential geographic locations

Percentage of consumers using the hydrogen network

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Mapping out the potential

2035

ENERGY TARGETS

Full decarbonisation of the power sector

National emissions will be reduced by 78% versus 1990 levels, in line with the Sixth Carbon Budget, including emissions from shipping and aviation

HOW WILL THE CONSUMER BENEFIT?

The delivery of a national backbone linking supply to demand network conversion will mean hydrogen is available to a broader range of consumers, including households and power generators

A focus on repurposing the existing assets will reduce the costs of transitioning from natural gas to hydrogen for consumers

The first consumers in Northern Ireland are able to access hydrogen

TECHNICAL DETAIL

Between 10 -20% of natural gas connections have converted to hydrogen, with growth in domestic and commercial connections

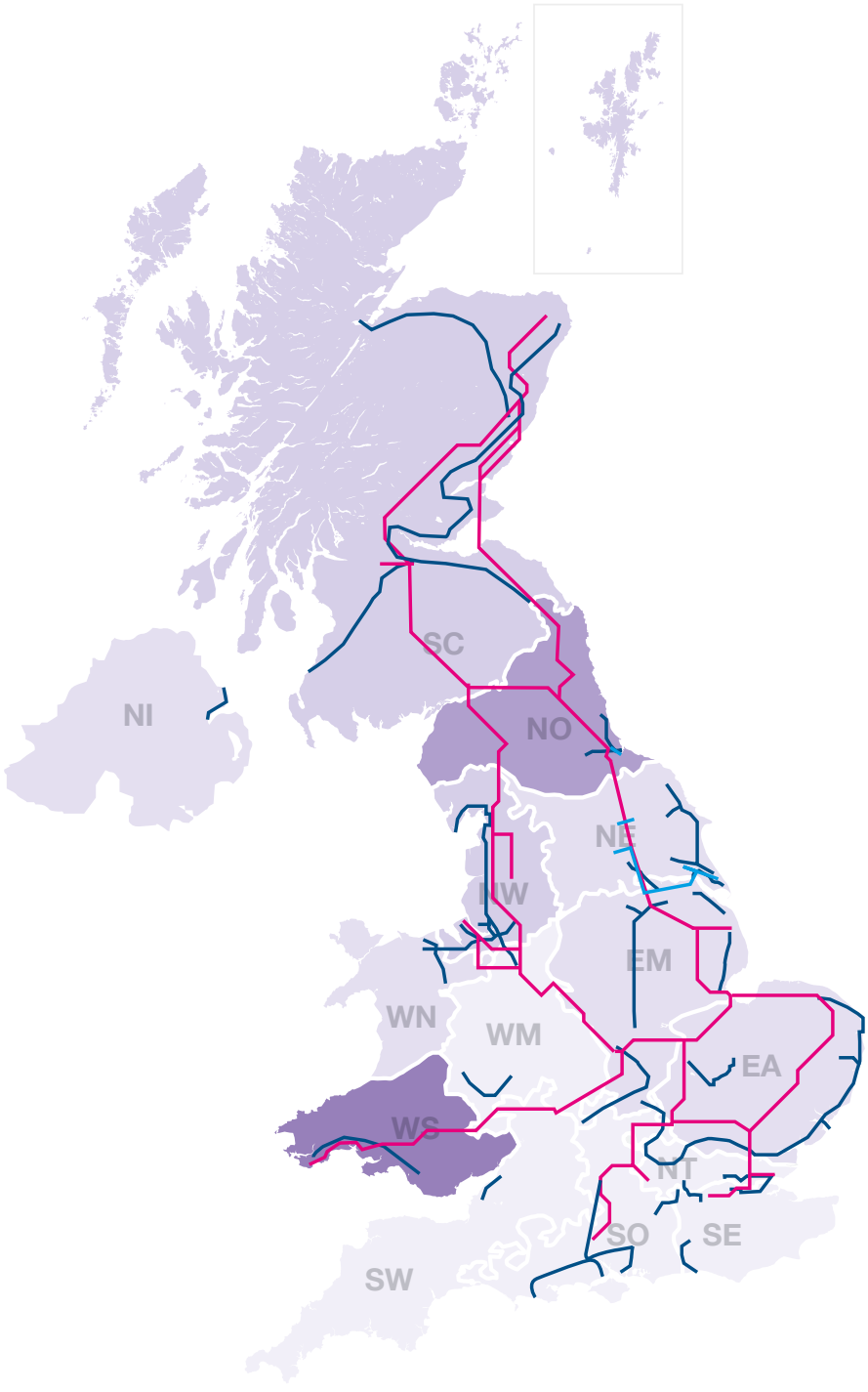
The backbone of infrastructure connects into hydrogen production and storage assets, serving demand from power stations, industrial consumers and the gas distribution networks

Converted pipelines will enable future hydrogen flows across interconnectors between Great Britain and Europe, for example at Bacton or from the Scottish Coast

Production scales across the country, spreading from industrial clusters as blue and green production increases in those areas

Green hydrogen production from dedicated or curtailed renewable energy will become more widespread as the deployment of renewables continues to increase

As the global hydrogen economy develops, imports of hydrogen could come into the country by the mid-2030s



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DEMAND

As we see more industrial demand, residential and commercial demand also grows as hydrogen increasingly decarbonises heat, alongside heat pumps and heat networks

CARBON CAPTURE & STORAGE

As more carbon is captured in industry, blue hydrogen production and the power system, new CCUS facilities are built off the East Coast

BLUE HYDROGEN PRODUCTION

Blue hydrogen production increases materially to over 70 TWh a year, including in places such as Cumbria, Southampton and the West Midlands

GREEN HYDROGEN PRODUCTION

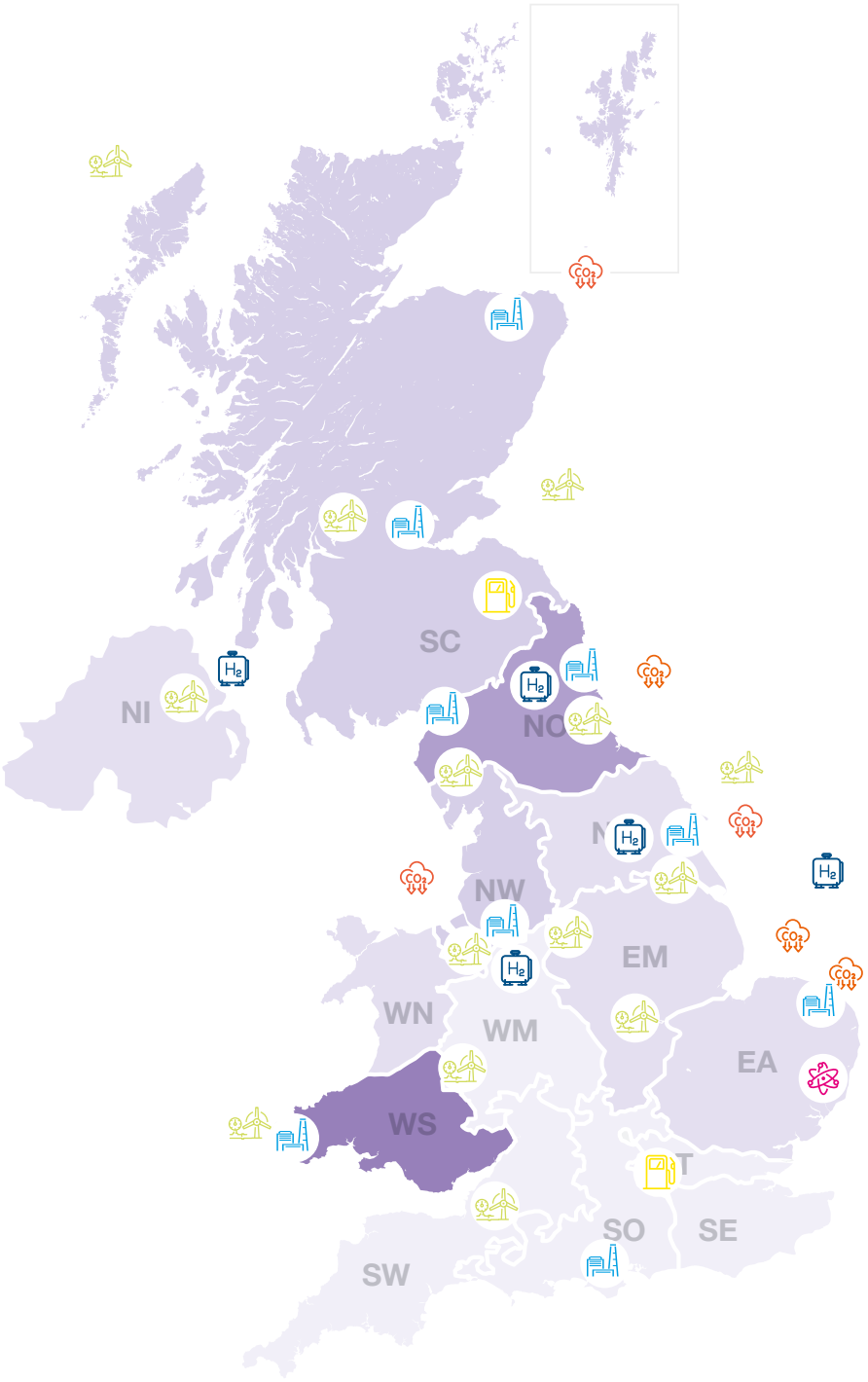
The UK power system is now decarbonised with as much as 36 TWh green hydrogen produced from wind (offshore and onshore) and solar

STORAGE

Hydrogen storage expands, with new facilities in Northern Ireland and the repurposing of Centrica's Rough facility

HYDROGEN FOR TRANSPORT

Hydrogen refuelling facilities become increasingly available at major transport hubs down the spine of the country and at key locations such as ports like Holyhead



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Percentage of consumers using the hydrogen network

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Mapping out the potential

2040

ENERGY TARGETS

UK becomes a net energy exporter

HOW WILL THE CONSUMER BENEFIT?

Consumers beyond industrial clusters and urban areas will be able to switch to hydrogen if they choose

Hydrogen export potential in Scotland, Northern Ireland and Wales, due to onshore and offshore wind potential, begins to be realised - creating additional economic opportunities

In areas of high electrification, where there is little demand for piped natural gas or hydrogen, parts of the network could be mothballed or decommissioned

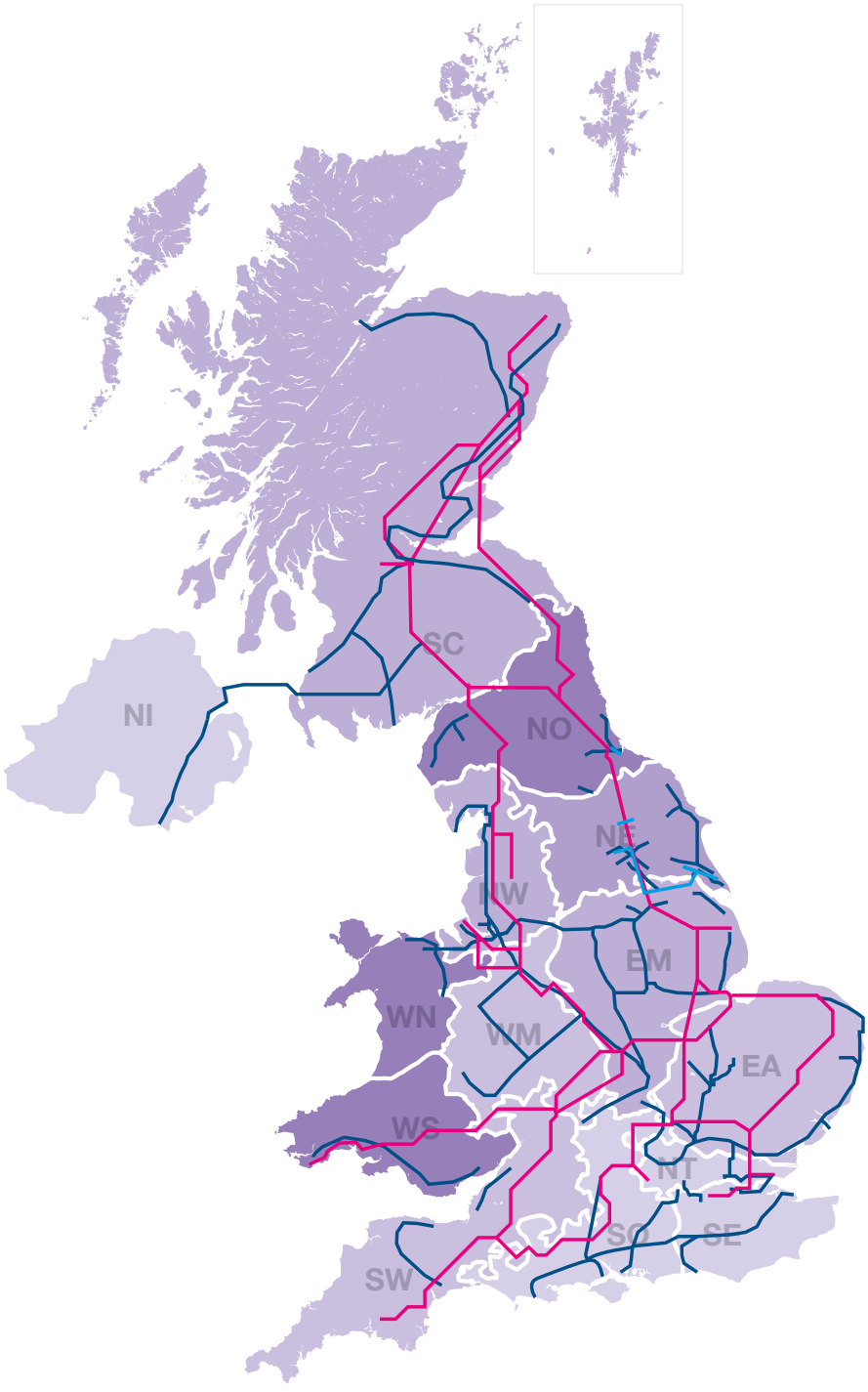
TECHNICAL DETAIL

Although some consumers remain using natural gas, between 30-40% of connections to our network are now using hydrogen

The map shows increasing connection between the hydrogen centres that developed in the 2030s

In some areas this will require new local transmission pipelines to be built and connected to others providing local transmission backbones, notably in Scotland and Wales.

As hydrogen production outstrips local demand, the national hydrogen backbone will allow hydrogen to flow to the rest of the UK, the island of Ireland and other European markets



Demand volumes are predicted and pipelines are a visual representation of potential geographic locations.

Pipeline developments

- New and repurposed National Transmission System pipes
- New and repurposed Local Transmission System pipes
- New third party pipes

Percentage of consumers using the hydrogen network

0-10 11-20 21-30
31-40 41-50 51-60
61-70 71-80

DEMAND

Residential and commercial conversion of the natural gas network is now firmly underway, with as many as 9m homes and businesses now using hydrogen for heat

CARBON CAPTURE & STORAGE

Further facilities are added as volumes of carbon captured across the economy increases

BLUE HYDROGEN PRODUCTION

Production capacity of blue hydrogen likely to more than double as hydrogen decarbonises more demand, including in South Wales

GREEN HYDROGEN PRODUCTION

Green production volumes continue to increase, including the South East, as dedicated renewables are used to produce the hydrogen needed for consumers there

PINK HYDROGEN PRODUCTION

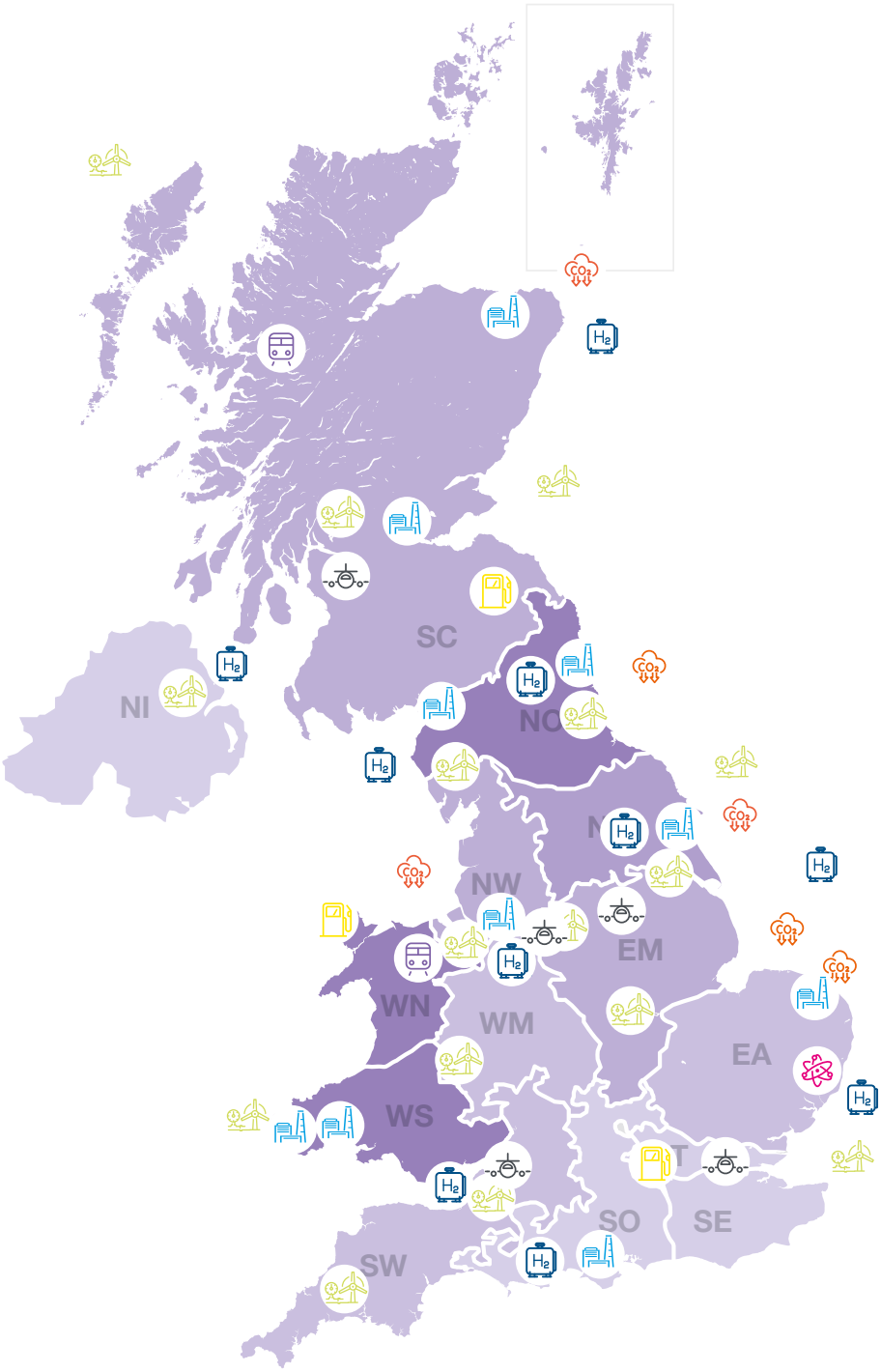
Hydrogen from the new nuclear site at Sizewell is produced

STORAGE

Storage capacity is now around 30 TWh, with new facilities supporting centres of demand including Morecambe Bay, the South-East and the Solent

HYDROGEN FOR TRANSPORT

We could start to see hydrogen used in aviation at airports such as Heathrow, Manchester, Liverpool and Glasgow, and some rural trains also start running on hydrogen



- Carbon Capture and Storage
- Blue hydrogen production
- Green hydrogen production
- Pink hydrogen production
- Hydrogen storage
- Hydrogen refuelling station
- Trains running on hydrogen
- Airports using hydrogen as aviation fuel
- Hydrogen exports

Infrastructure is a visual representation of potential geographic locations

Percentage of consumers using the hydrogen network

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61-70 71-80

Mapping out the potential

2045

ENERGY TARGETS

Scotland achieves Net Zero, including a 25 GW hydrogen production target

Scotland exporting up to 94 TWh of hydrogen to the UK and other European markets by 2045[9]

Additional targets likely to emerge through future Governments

HOW WILL THE CONSUMER BENEFIT?

Consumers in all regions can access hydrogen by the mid 2040s

Areas where there is a shift towards low carbon hydrogen see extensive conversion of pipelines at all levels, extending the life of existing infrastructure and helping to keep the cost of decarbonisation low for consumers

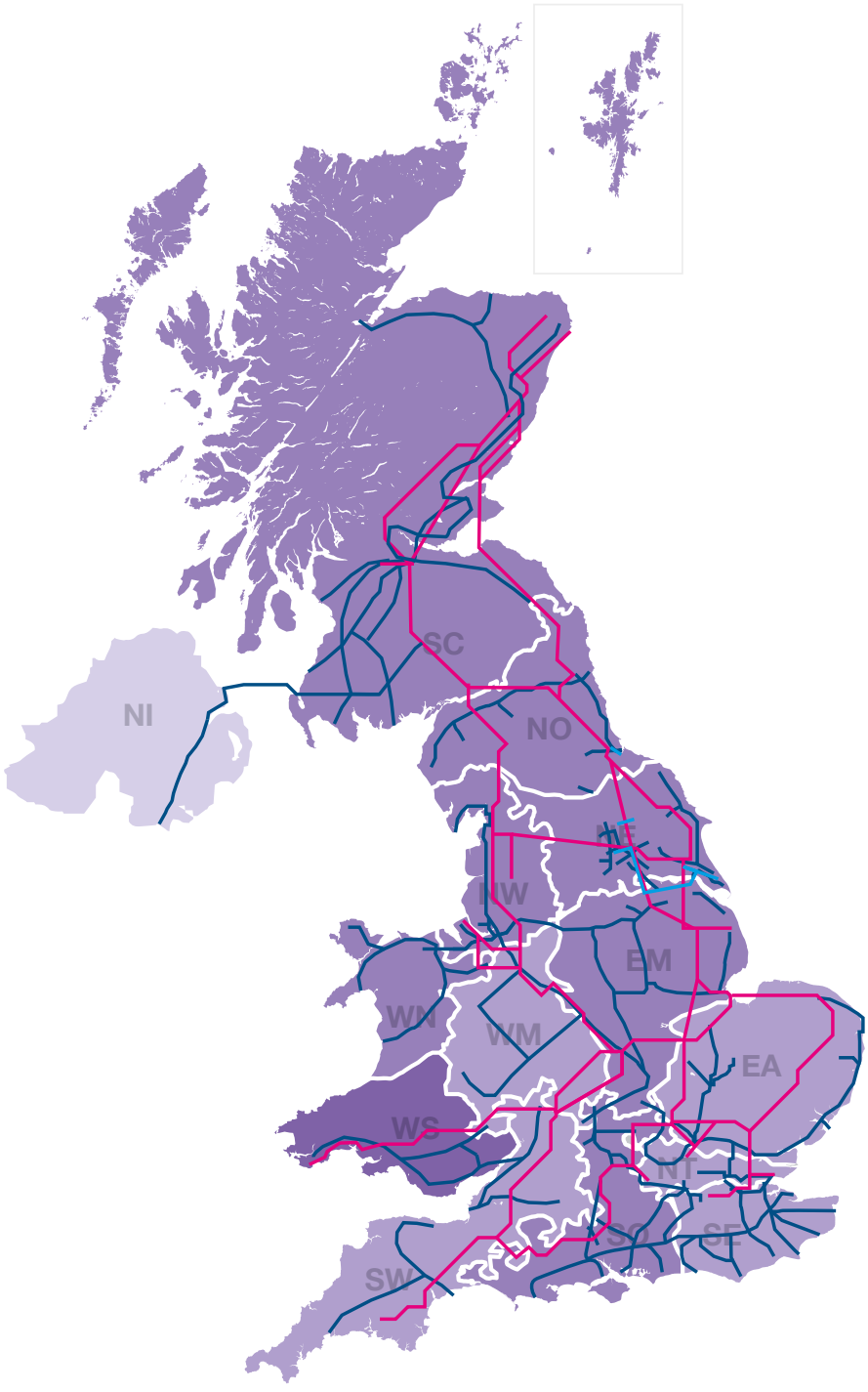
TECHNICAL DETAIL

Between 50-60% of connections to our network are now using hydrogen

The natural gas network is increasingly used for transporting and storing hydrogen, rather than natural gas. There is residual natural gas in the system but levels are limited. For example, there is only around 10% of current methane demand in the North East, Northern Cumbria and much of Yorkshire

Additional large-scale storage comes online, further pipelines converted in the south

9. Scotland Hydrogen Action Plan https://www.gov.scot/publications/draft-hydrogen-action-plan/



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Percentage of consumers using the hydrogen network

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DEMAND

Scotland reaches Net Zero. Approximately 14m homes and businesses are now using hydrogen, large parts of the natural gas network has now been converted

CARBON CAPTURE & STORAGE

We now have the CCUS facilities needed to support Net Zero in Scotland and put England, Wales and Northern Ireland on the right path for 2050

BLUE HYDROGEN PRODUCTION

Growth in new production facilities is likely to reduce by 50% as green takes more share

GREEN HYDROGEN PRODUCTION

As renewable power prices decline, green hydrogen is now likely to be the cheapest form of production, seeing growth distributed across the country

STORAGE

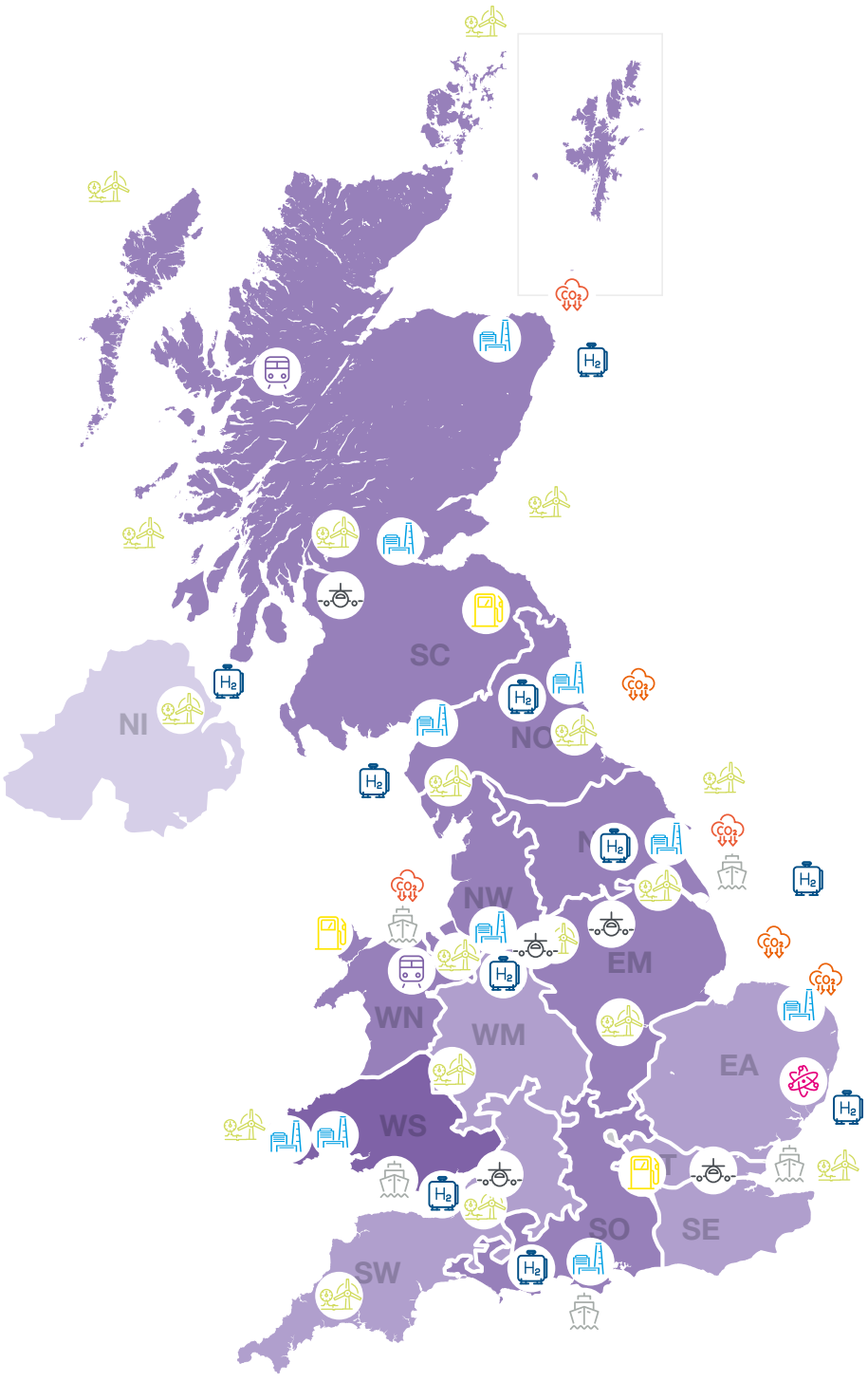
Most strategic storage has been built by now however further sites will continue to be developed to accommodate increased green production

HYDROGEN FOR TRANSPORT

Key ports, including Felixstowe, Liverpool, Southampton and in South Wales are increasing supplies of hydrogen or derivatives to decarbonise shipping

EXPORTS

We may see the first maritime based hydrogen exports to regional markets beyond the UK



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Infrastructure is a visual representation of potential geographic locations

Percentage of consumers using the hydrogen network

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Mapping out the potential

2050

ENERGY TARGETS

UK to achieve Net Zero

Additional targets likely to emerge through future Governments

HOW WILL THE CONSUMER BENEFIT?

At the end of our mapping scenario, the use of hydrogen by consumers is widespread, providing low carbon energy across the economy, providing choice to consumers and keeping businesses viable

TECHNICAL DETAIL

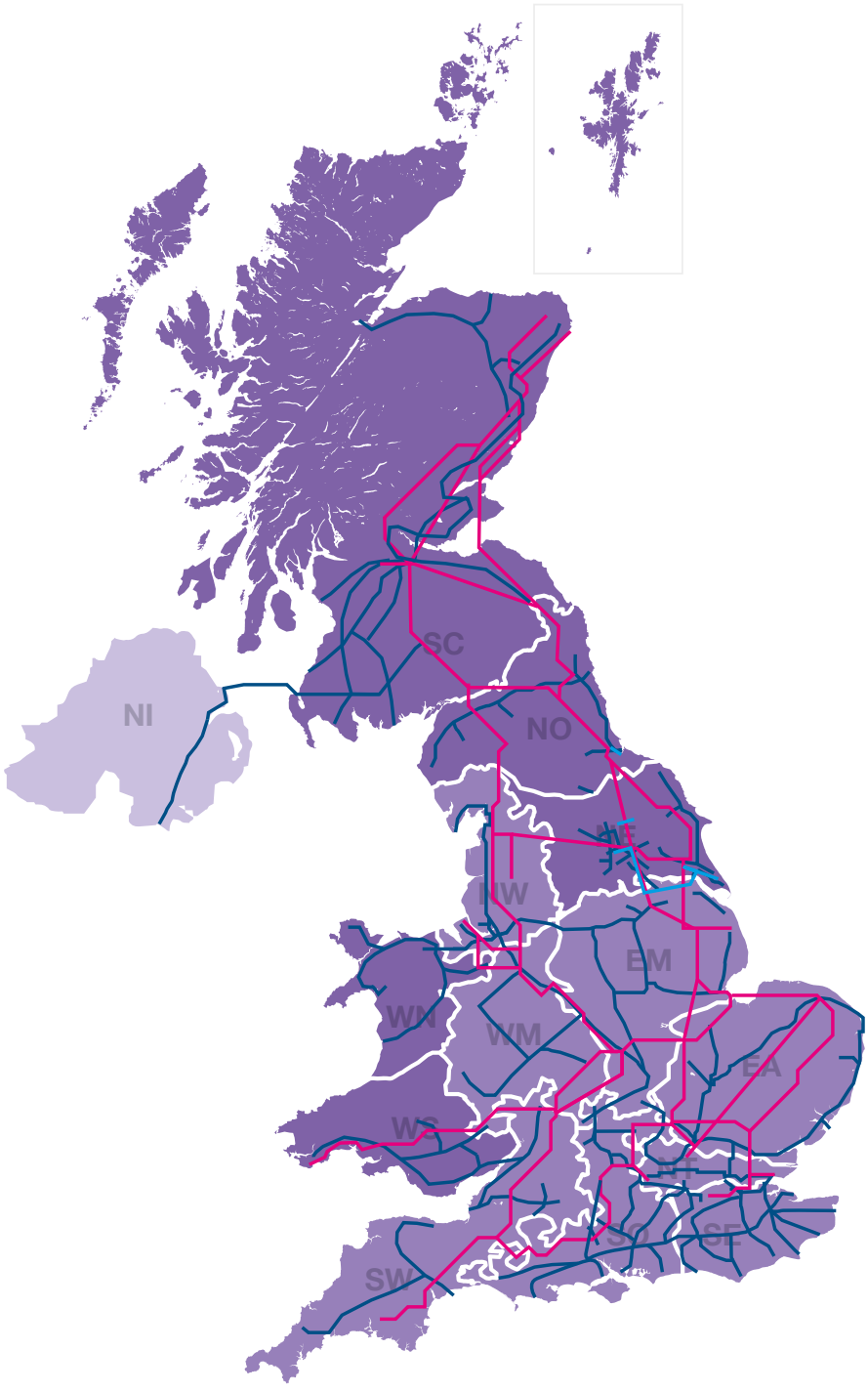
Between 60-70% of connections to our network have converted to hydrogen, with the remainder largely using alternative forms of low carbon energy

Throughout the transition networks are focused on repurposing assets where it makes sense, reducing overall costs

There will be a need for new pipelines in some areas – for example to support hydrogen transmission at national and regional level alongside the movement of natural gas

In some areas of high hydrogen demand, new pipelines will be built

Lower overall demand for gas will mean that by 2050 some areas of the distribution network will no longer be required. Parts of the pipeline network could be partially decommissioned in order to preserve network safety and reduce ongoing costs



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Percentage of consumers using the hydrogen network

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DEMAND

Nearly 16m homes and business and around half of all industrial consumers are now connected to the hydrogen network

CARBON CAPTURE & STORAGE

Nearly all carbon from industry, remaining gas power plants and blue hydrogen production is being captured and stored – as much as 75-175 $MtCO_2$ annually

GREEN AND BLUE HYDROGEN PRODUCTION

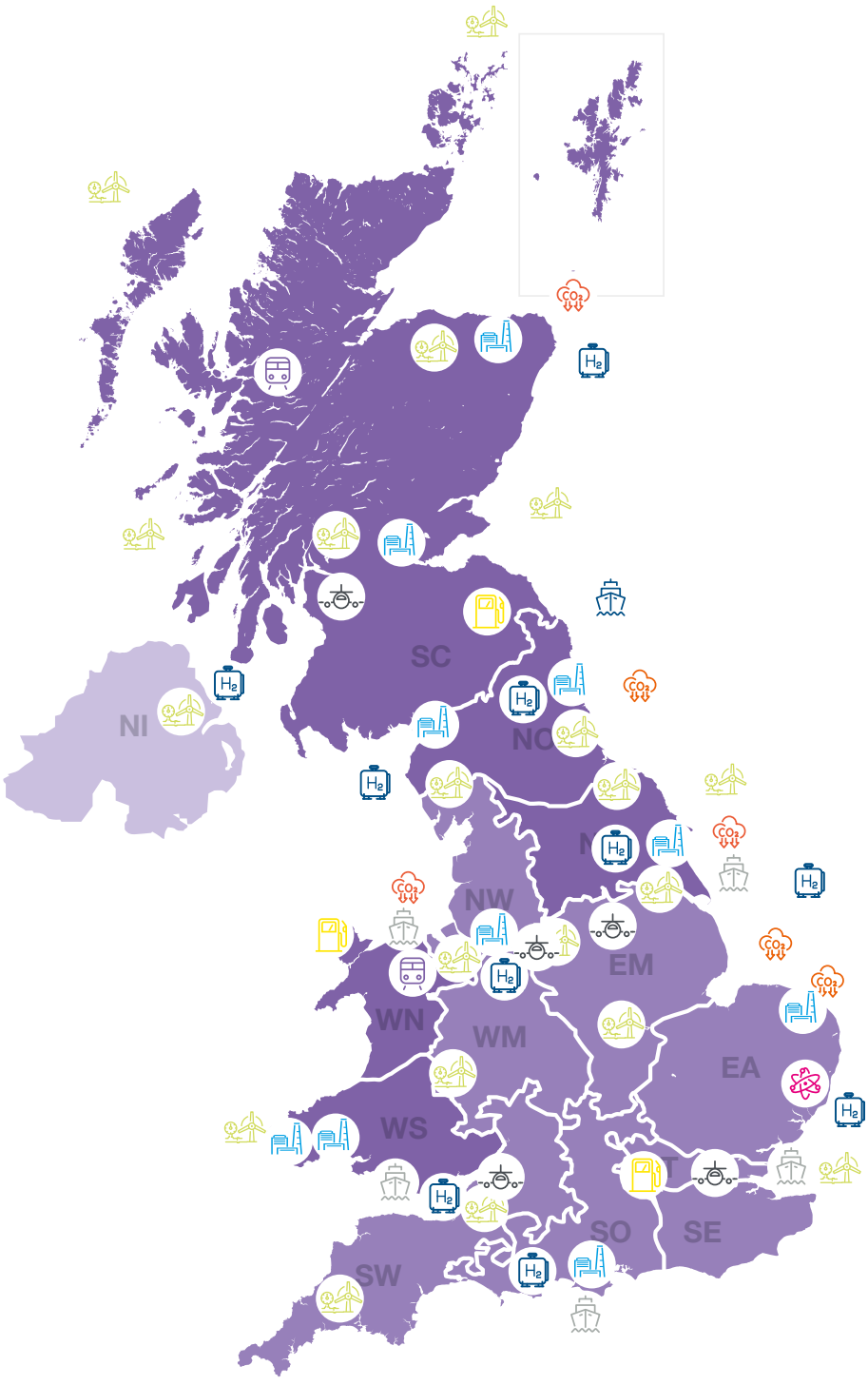
We now have nearly 400 TWh of hydrogen per year produced from both blue and green combined

STORAGE

We now have between 40-50 TWh of hydrogen storage capacity across the UK, providing energy security for hydrogen consumers and flexibility for the wider energy system

HYDROGEN FOR TRANSPORT

Various forms of transport are now demanding over 100 TWh of hydrogen per year



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The next steps needed to deliver this vision for consumers

The gas networks are ready to deliver hydrogen infrastructure in a UK-wide, coordinated way which brings value to consumers and unlocks the economic potential of a decarbonised energy system.

The gas networks in GB stand ready to invest £6.8bn in hydrogen-focused innovation projects by 2031/32, and we are already delivering an extensive range of programmes, operating in collaboration with consumers - drawing on years of expertise running safe, reliable networks, the know-how of our workforce and investment in innovation.

We understand that the industry has a duty, as those on the frontline of delivering hydrogen to consumers, to be proactive in doing our part to deliver this vision.

Our commitment, through the pledges made in this report, is outlined opposite.

1. Play a lead role in delivering against the UK's hydrogen ambitions	✓	Deliver the trials and projects outlined by Government this decade, such as the H100 Neighbourhood Trial, the Hydrogen Village Trials and Town Pilot
	✓	Continue development of discrete projects with a range of partners, working with Ofgem on funding and deployment
2. Conduct further research and testing in an open and transparent manner	✓	Continue our internal modelling and scenario planning in each network, engaging others in the industry to enable whole systems planning
	✓	We will bring new data together periodically to update the hydrogen vision maps and publish on the ENA website
	✓	Continue to build evidence to support the safety case for hydrogen
3. Engage with consumers across our networks on delivering Net Zero	✓	Communicate with current gas consumers on the potential role for hydrogen in the energy system transition
	✓	Engage with devolved, regional and local authorities and other stakeholders to demonstrate the possibilities of hydrogen in our regions and understand future demand, capacity and location needs
4. Work collaboratively with all stakeholders across the sector using a 'whole systems' approach	✓	Support Government in gathering further evidence to enable the 2026 decision on the role of hydrogen for UK heating. As part of this ENA will: • Convene a meeting of CEOs and senior officials to take stock of progress to date in demonstrating the safety and feasibility of hydrogen for heat, and agree the critical areas of evidence outstanding including who is responsible for providing and verifying it and to what timescales • Convene meetings of gas and electricity networks to discuss respective approaches to network planning for Net Zero and agree areas where joint working will be useful
5. Invest in both developing a skilled workforce for the future and a UK supply chain	✓	Further develop our understanding of the skills and supply chain needs for conversion of the UK gas network, including: • Working with IGEM and EU Skills to develop and deliver hydrogen specific standards and training • Providing evidence to Government on future need, to inform planning for Net Zero. skills education • Work with supply chain to develop skills, logistics and home grown talent • Develop new themes of innovation to support our consumers through Net Zero

The next steps needed to deliver this vision for consumers

The gas networks cannot achieve this alone. We will need stakeholders across the industry to work with us, particularly policymakers in Whitehall and the devolved administrations, as well as those responsible for developing the frameworks for regulation and planning of the hydrogen network. To enable and accelerate development of hydrogen, we will need:

1. Government to ensure that the current high levels of political commitment to hydrogen production development are matched for hydrogen network infrastructure development

Following the positive recent announcements on funding allocation for blue and green hydrogen production, there is a need for political commitment and Ministerial recognition of hydrogen beyond just this first step, which involve network infrastructure build out.

Greater clarity would help the sector to align investments into production, storage, distribution, and end use, recognising that these are multi-year projects to become operational.

2. A clear roadmap to be produced for the development of a new hydrogen regulatory and market framework

A new industry framework including a Hydrogen Code will be required for the roll out of hydrogen for heating. Government working with Ofgem must appoint a framework developer and set out a process, working with industry, to have the initial arrangements in place for the first hydrogen Town in 2030.

3. Government to publish a strategic policy statement for Ofgem by the summer of 2023

This will set out a new Net Zero statutory duty of Ofgem and includes the role, responsibilities, and decisions it must make in relation to hydrogen, electricity and other low carbon fuels.

4. Government to expedite the development of hydrogen transportation & storage business models earlier than the current 2025 timeline. This should include committing to introducing enabling legislation for these by spring 2024 and putting practical interim measures in place for early movers

The current government timeline of 2025 to develop these business models represents a risk to delivery of key decarbonisation targets, especially when legislative change to enact the business models is factored in.

Expediting the timeline to finalise the models and the enabling legislation in 2024, as well as putting in place interim measures for the earliest projects, will ensure that the UK can meet the 2030 hydrogen production target and speed up the scaling up of hydrogen in the 2030s, particularly with a view to meeting the target to decarbonise the power sector by 2035.

5. The regulator to have the tools and mandate to enable early investment in critical hydrogen infrastructure

Ofgem should be empowered with the right mandate to enable regulation and funding of hydrogen infrastructure now. Without this, there is a risk that the next price control period will represent a missed opportunity with regards to investment in hydrogen infrastructure, despite the proposed 2-year delay to the gas distribution price control.

6. The Future System Operator to have a strategic planning role when it comes to hydrogen from the first day of its implementation

This role should include a) the right mandate to enable decision-making and b) sufficient resources with the right capabilities to take a genuinely whole system view.

This applies equally to the Regional System Planners (RSPs) recently proposed by Ofgem, which would determine what network infrastructure will be required to support decarbonisation at a local level.

7. Government to make a positive decision on blending as soon as possible in 2023, with a view to implementation in 2025

Indicating this direction of travel and ensuring that the HSE can review the necessary blending technical and safety evidence as soon as possible is important to provide industry with certainty on a critical transitionary step to enable the hydrogen vision.

An indication from government on the direction of travel and timeline for transmission level blending is also important.

8. Government to mandate hydrogen-ready boilers from 2026

This remains a low regrets way of preparing for the rapid decarbonisation of heat and will help ensure investment planned by boiler manufacturers remains committed to the UK.

9. Greater Government leadership on the rollout of heat decarbonisation, including active government support for trials

There is a need for a clarity on what the 2026 decision on hydrogen heating will entail, the process that will be followed to make the decision and how low carbon heat will be rolled out following this.

Public government support to low carbon heat trials would significantly help with securing public acceptance to the changes that will be needed to enable decarbonisation of heat.

10. Government commitment to the development of the hydrogen economy in Northern Ireland

Similar policy steps are needed to enable the hydrogen vision in Northern Ireland, including:

- Establishing a formal framework for whole energy system planning in NI
- Establishing a formal framework to coordinate gaseous interconnection between NI and GB
- Appropriate business models and a supportive regulatory framework
- Key policy decisions around hydrogen blending and the role for hydrogen in different end-uses.

Our projects to deliver the hydrogen vision

Network readiness

The UK gas pipeline network does not transport hydrogen to consumers today.

To guarantee hydrogen can be transported and stored with the same levels of safety and resilience consumers have come to expect today, investments will need to be made. UK gas network companies are carrying out extensive work to ensure the network will be 'hydrogen ready'.

CASE STUDY

Modernising local gas pipes across Great Britain

Network company	Cadent, Northern Gas Networks, SGN, Wales & West Utilities
Project start date	2002
Project end date	2032

Through a national project upgrading the old cast iron pipework that has transported natural gas to consumers for decades, the Iron Mains Risk Reduction Programme will see Britain's gas networks invest a further £28bn upgrading the network with new polyethylene plastic hydrogen-ready pipes by 2032. This nationwide programme reduces emissions whilst granting Britain's homes and businesses more choice over which zero carbon technologies they will be able to use in the future, directly reducing greenhouse gas emissions, making the network more cost effective to run and playing a role in delivering our decarbonisation goals.

FutureGrid links to the H21 Microgrid on site allowing networks to collaborate across this important research and demonstrate a full hydrogen grid in miniature

CASE STUDY

Testing use of hydrogen in the gas transmission network

Network company	
Project start date	April 2021
Project end date	2023

FutureGrid is an ambitious programme to build a hydrogen test facility from decommissioned assets at a facility in Cumbria.

It aims to demonstrate how the network can transport hydrogen at a variety of different concentrations from 2% to 100%. This testing will generate new knowledge and understanding of how these assets will perform as part of a future hydrogen system. This will inform the wider hydrogen transition plan for the network and identify where further work may be required.

CASE STUDY

Testing use of hydrogen in the gas distribution network

Network company	Northern Gas Networks
Project start date	Phase 2 started in 2020
Project end date	July 2023

H21, led by Northern Gas Networks, is a five-year programme of research on behalf of the gas industry exploring whether today's gas network can be converted to transport hydrogen in the future.

After proving that a conversion was technically possible and economically viable, the H21 team set about demonstrating that a hydrogen network can be as safe as today's natural gas network. This is split into four phases:

- Phase 2a – Appraisal of Network Operations
- Phase 2b – Unoccupied Network Trials
- Phase 2c – Combined QRA
- Phase 2d – Social Science Research

The team has completed an extensive research programme, ranging from testing public perceptions of hydrogen, to carrying out operational gas procedures under 100% hydrogen conditions on a purpose built MicroGrid and on a disused, disconnected gas network. The H21 results will inform the Government's decision about the future of the gas network.

Gas networks across Britain and Northern Ireland are getting ready to start **blending hydrogen around the country.**

Blending 20% hydrogen into the gas grid will reduce carbon emissions by the equivalent of 2.5 million cars a year, without consumers have to make any changes to the appliances they use or how they use them. This low cost, low disruption, low regret step in decarbonising domestic heat will kick start the UK hydrogen economy, develop hydrogen supply chains and help balance the emerging hydrogen system, when supply outstrips demand. The Government is due to make a decision on whether to allow blending in Great Britain later this year. The projects below are providing valuable evidence on feasibility, safety and consumer acceptance.

CASE STUDY

Blending hydrogen with natural gas in England

Network company	Cadent Your Gas Network / Northern Gas Networks
Project start date	**HyDeploy 1 – 2019, HyDeploy2 – 2021**
Project end date	**HyDeploy1 – 2020, HyDeploy2 – 2022**

The HyDeploy1 project started blending hydrogen into the gas network in 2019 at the Keele University campus in Staffordshire. The campus runs on a private gas network which saw consumers living and working in 100 homes and 30 university buildings receive a 20% blend of hydrogen over an 18 month period.

Following the success of this trial, HyDeploy2 started in August 2021 at Winlaton, Gateshead. For 10 months, consumers in 680 homes, a school and a church received a 20% blend of hydrogen. A recent study and maps published via ENA showed that there is around 60 TWhrs per year of blending capacity in the network, equivalent to the heat demand from 5m homes, and a potential carbon saving of around 10m tonnes of CO_2.

CASE STUDY

Blending hydrogen with natural gas in Northern Ireland

Network company	mutual energy
Project start date	**2026**

Project Curran is being developed by Mutual Energy in partnership with Phoenix Natural Gas. The project proposes to blend up to 20% hydrogen into the gas network around Larne, providing a hydrogen blend to approximately 5,500 consumers, including domestic, commercial and industrial. As Northern Ireland has a different utility regulator and Health and Safety body to Great Britain, this project will provide the evidence needed to help progress the economic, regulatory and safety frameworks for hydrogen blending in Northern Ireland. The project is currently in its pre-development phase, and, funding dependent, aims to be operational by 2026.

Our projects to deliver the hydrogen vision

Helping deliver industrial consumers' Net Zero plans

The gas networks are involved in several strategic projects that will deliver low carbon hydrogen at scale for industrial consumers across the country by 2030.

These projects will provide a route to decarbonisation for critical industries such as chemicals, refineries and potentially steel – at the same time protecting jobs and economic value, whilst ensuring UK industry can provide low carbon products for the future. In turn, industrial demand in clusters will become the keystone for the future development of the wider hydrogen economy.

CASE STUDY

North West of England

Network company	Cadent – Your Gas Network
Project start date	Operational by 2026
Project end date	Ongoing

In the North West, HyNet is building the infrastructure to produce, transport and store the low carbon hydrogen needed to decarbonise industry and heavy transport – and in future provide low carbon heat and hot water – across the North West and North Wales.

The project will deliver £31bn of economic value by 2050, provide 6,000 permanent high-skilled local jobs and reduce carbon emissions by 10m tonnes a year by 2030. It will also ensure one of the UK's industrial heartlands can operate in a low carbon future, safeguarding local jobs and protecting the economy from offshoring.

CASE STUDY

South Wales

Network company	Wales&West Utilities
Project start date	2019
Project end date	2025

As the UK's second highest emitting cluster, decarbonising the South Wales Industrial Cluster (SWIC) will be key to reaching Net Zero. The Cluster could create 5,000 jobs and provide Net Zero options for the area's existing industry.

The SWIC Deployment Project involves 17 partners working on feasibility and engineering design studies for projects to reduce emissions in the region. It is working alongside and supporting key regional investment plans such as the development of Lanzatech's Project DRAGON and the RWE Pembroke Net Zero Centre. These pioneer projects aim to provide the foundations for cluster growth and reach Final Investment Decision by 2025.

CASE STUDY

South of England

Network company	SGN
Project start date	FEED start mid-2024
Project end date	FEED end 2026

The Southampton Water project will set out a roadmap for decarbonising Southampton Industrial Cluster and surrounding area. The project's first phase would see the Fawley hydrogen cluster be operational from 2027, supplying hydrogen to blend 20% by volume into the local network, partially decarbonising heat across the region.

Conversion of the natural gas network to 100% hydrogen will follow the first phase, before expanding to Portsmouth and Bournemouth. Early blending could reduce CO_2 emissions in the area by 1.9m tonnes per year, increasing to 9.5m tonnes per year in later stages.

CASE STUDY

Scotland

Network company	SGN
Project start date	October 2021
Project end date	March 2023

The Aberdeen Vision Project focuses on the transport and use of hydrogen produced from reformed natural gas from St Fergus, Scotland, which could save 1.5 $MtCO_2$ per year.

The study demonstrated that a dedicated pipeline from St Fergus to Aberdeen would enable the transfer of the Aberdeen regional gas distribution system to 100% hydrogen, and that 2% hydrogen can be injected into the network at St Fergus and distributed beyond. This would be followed by build out to supply the Aberdeen gas networks and enable low cost hydrogen transport applications.

CASE STUDY

Midlands – England

Network company	Cadent Your Gas Network; National Gas
Project start date	June 2022
Project end date	April 2023

The Hydrogen Valley is a collaborative study between National Gas and Cadent assessing the hydrogen supply and demand potential of the West Midlands, Cambridgeshire, Peterborough, North East Anglia and East Lincolnshire, providing evidence for early investment in the region's gas network and hydrogen infrastructure.

The programme of work could deliver up to 25% of the emissions reduction required to reach Net Zero in the region, support up to 25,000 jobs and create a further 9,000 in the region's hydrogen economy. It could also attract up £28bn in private investment.

Our projects to deliver the hydrogen vision

Joining up the regions

Most of the hydrogen we see today is produced and used in the same location, this will change over time.

As shown in the Hydrogen Strategy Roadmap supply and demand will be largely co-located in the early part of this decade. As we get closer to 2030, and certainly beyond, there will be a need for national and regional hydrogen transmission networks to connect large centres of production to consumers in different, and more distant, places.

CASE STUDY

A hydrogen transmission system for the UK

Network company	
Project start date	June 2021
Project end date	December 2035

Through the phased repurposing of around 2,000km (approximately 25%) of the UK's existing transmission pipelines, Project Union will develop a low cost hydrogen 'backbone'.

It will enable decarbonisation through fair access to low carbon hydrogen, linking supply and demand for UK consumers across industry and power, while providing optionality for heat and transport. It will also provide interconnection opportunities to Europe and Ireland. Project Union could support approximately £300m annual economic value added and 3,100 jobs at peak construction, while de-risking planned hydrogen supply and demand projects and increasing investor confidence that there will be access to a diverse, Great Britain-wide consumer hydrogen market.

CASE STUDY

North East Scotland

Network company	SGN
Project start date	2023
Project end date	2026/27

The North East Network & Industrial Cluster Development Project determined the feasibility of reconfiguring SGN's gas distribution network in the North East and Central belt of Scotland to separately transport hydrogen to end consumers and captured carbon dioxide to geological stores. The project outlines the practical steps required to rapidly decarbonise a significant part of Scotland's homes and industry. It demonstrates how hydrogen can play a leading role in delivering the Scottish Government's target of one million homes with low carbon heat by 2030.

CASE STUDY

North East of England

Network company	Cadent Your Gas Network; Northern Gas Networks; Pipelines
Project start date	Operational by 2027
Project end date	Ongoing

East Coast Hydrogen will focus on decarbonising heavy industry based around the Humber and Teesside, providing the infrastructure necessary to later decarbonise the wider economy.

Drawing on the region's natural assets, including existing and potential hydrogen storage facilities, this project will build on hydrogen production in the North East's large industrial cluster. It will connect over 7 GW of hydrogen to 39,000 businesses and over 4m homes, saving up to 11 Mt of carbon emissions annually and providing 10 TWh of hydrogen storage capacity. Creating 9,000 jobs by 2026, the East Coast cluster will be key to the £20bn a year GVA by 2050 target for offshore wind and hydrogen production and supply from the North Sea.

CASE STUDY

Wales

Project lead	Wales&West Utilities
Project start date	November 2022
Project end date	Ongoing

As part of the South Wales Industrial Cluster, the Hyline Cymru pipeline will connect low carbon hydrogen production with industrial demand and could facilitate the conversion of home heating to hydrogen. The project could create 5,000 new jobs, while supporting and de-risking decarbonisation plans for hydrogen producers and industrial consumers . It is working alongside and supporting key regional investment plans such as the development of Lanzatech's Project DRAGON, which aims to be the world's first commercial-scale facility to transform waste gases into sustainable jet fuel.

CASE STUDY

South East and East of England

Network company	Cadent Your Gas Network; SGN; Pipelines
Project start date	November 2022
Project end date	Ongoing

Capital Hydrogen will connect low carbon hydrogen production and strategic supply in London, the East and South East of England, developing a secure and resilient low carbon economy in the region by decarbonising industry and heavy transport. The project has the potential to deliver £40bn of GVA to the UK economy and create 40,000 jobs in manufacturing and the wider supply chain. It will also save over 7.8 $MtCO_2$ per year through hydrogen deployment, working towards achieving the Mayor of London's preferred 'Accelerated Green' Pathway to Net Zero.

Our projects to deliver the hydrogen vision

Decarbonising heat

Since 2017, there has been extensive innovation and investigation carried out to explore the role that hydrogen can play in decarbonising heat for homes and businesses.

Networks have supported wide ranging activity to test whether hydrogen can be safe and practical for home heating, cooking and hot water needs. That work has moved from lab-based investigation to demonstration homes fitted with household gas appliances fuelled entirely by hydrogen, allowing the public to experience a low carbon gas fuelled home.

Networks are partnering with each other and Government to extend real world trials into multiple homes. These trials are important for our understanding how homes and buildings can be decarbonised in line with Net Zero, and how conversion would work in practice. They are critical in meeting Government's aim of developing low carbon hydrogen as and option for decarbonising heat in the 2030s.

CASE STUDY

Using hydrogen in a new neighbourhood in Scotland

Network company	SGN
Project start date	2022
Project end date	2024-27

The H100 Fife project aims to demonstrate the world's first 100% green hydrogen gas network, comprising renewable power generation, hydrogen production and storage, pressure reduction, odorisation and distribution. Supplied by an existing 7 MW offshore wind turbine, H100 Fife will provide 300 consumers in Levenmouth, Fife with low carbon heating.

The project will bring investment totalling £32m, deliver jobs to the local area and save almost 3,000 tonnes of CO_2 over its lifetime, equivalent to taking the cars of half of the participating homes off the road.

CASE STUDY

Hydrogen Village trials in Ellesmere Port and Teesside

Network company	Cadent Your Gas Network; Northern Gas Networks; Wales & West Utilities
Project start date	2020-23
Project end date	2027-28

Cadent and NGN (with support from WWU) have submitted detailed designs for a 100% hydrogen village trial in Ellesmere Port and Teesside. The Department for Energy Security and Net Zero are reviewing the submissions and a Village trial location will be chosen by Autumn 2023.

Submissions for both trials set out how an existing natural gas network could be converted to 100% hydrogen through a planned conversion programme. Both potential locations have a diverse building stock, including homes, businesses and industrial units, which would switch from natural gas to hydrogen for heat and hot water, with minimal disruption. All appliances would be converted to low carbon equivalents (hydrogen boilers or heat pumps) for free. The evidence gathered from the chosen trial will support the Government's decision on the role of hydrogen in heating in 2026.

CASE STUDY

Hydrogen Production using Constrained Energy

Network company	SGN
Project start date	2022
Project end date	2023

The Southwest of Scotland is characterised by high numbers of onshore renewable energy projects, particularly onshore wind projects that are currently under development or older renewable generation projects whose primary funding mechanism (Renewable Obligation Certificates 'ROCs') is coming to an end. The area also faces challenging electricity network constraints.

The study will identify potential locations for hydrogen production which optimise available renewable power and reduce electricity transmission losses. These outputs will inform the next phase of the study, creation of a high-level strategy for the conversion of the gas network in the region, in a manner that minimises cost and maintains availability of supply to the consumer.

Appendix

Developing the maps

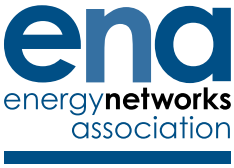
The map elements in England, Scotland and Wales have been produced using datasets developed in a programme of work for the UK Government. This looked to develop a set of future scenarios for the gas network, with the aim of exploring the network configuration options required to support the supply of 100% hydrogen for power and transport, as well as to homes, businesses, and industry in a range of scenarios.

This modelling considered a range of scenarios, from those considering more of a role for hydrogen to those where alternatives such as electrification was used to meet more demand. The scenarios are based on publicly available FES and CCC data. Given this report is intended to provide a vision of the potential hydrogen economy we could see, the scenario taken from the modelling is one of those with higher volumes of hydrogen demand.

As Northern Ireland was not part of this modelling exercise, the Northern Ireland elements of the maps have been developed using a slightly different methodology. We have extrapolated data from the 'Balanced Scenario' in a Guidehouse report commissioned by the five Northern Ireland gas network operators in 2021 entitled "Northern Ireland Pathways to Net Zero 2050". The Northern Irish picture is understandably quite different to the rest of the UK, on the grounds that current gas connection penetration in Northern Ireland is much lower (currently around only 35% or 300,000 properties are connected to the gas network) and Northern Ireland has much greater biomethane potential per unit of gaseous networked demand.

Alongside the asks from the Government, each of the networks are carrying out their own detailed work on the future of their networks to inform their own planning and preparedness. Gas networks will continue to work together in planning for future hydrogen roll out. This Vision, and the maps which underpin it, are intended as live outputs which we will continually revisit and refine over time as the pipeline of early supply and demand becomes clearer, informed by real world projects. By putting this information into the public domain our aim is to support politicians and policymakers, as well as businesses and investors, of all sizes and parts of the UK economy, with their planning for the availability of low carbon hydrogen.

Decisions about the configuration of the future gas network will need to reflect a broad understanding of wider energy infrastructure needs, particularly electricity networks. As we see today, electricity and gas will work alongside each other to deliver reliable energy – with carbon emissions becoming lower over time. In some areas, gas networks are already taking such considerations into account in their planning.



Energy Networks Association
4 More London Riverside,
London, SE1 2AU
t. +44 (0)20 7706 5100
w. energynetworks.org
@EnergyNetworks