GAS GOES GREEN

BRITAIN'S HYDROGEN NETWORK PLAN

EXECUTIVE SUMMARY

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ena energynetworks association

ABOUT

ABOUT ENA

We're the voice of the networks. We're the industry body for the companies which run the UK & Ireland's energy networks, keeping the lights on and gas flowing.

Our members own and operate the wires and pipes which carry electricity and gas into your community, supporting our economy.

The wires and pipes are the arteries of our economy, delivering energy to over 30 million homes and businesses across the UK and Ireland. To do this safely and reliably, the businesses which run the networks employ 45,000 people and have spent and invested over £60 billion in the last eight years.

We're creating the world's first zero-carbon gas grid by speeding up the switch from natural gas to hydrogen for the 85% of UK households connected to the gas grid.

Gas Goes Green, an ENA programme, is our plan to deliver net-zero emissions in the most cost-effective and least disruptive way possible. It is a blueprint for our gas networks to meet the challenges and opportunities of climate change.

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Participating Gas Goes Green members are the gas network companies: Cadent, National Grid Gas, Northern Gas Networks, SGN and Wales & West Utilities.

ABOUT DNV GL

We are the independent expert in risk management and quality assurance. Driven by our purpose, to safeguard life, property and the environment, we empower our customers and their stakeholders with facts and reliable insights so that critical decisions can be made with confidence. As a trusted voice for many of the world's most successful organizations, we use our knowledge to advance safety and performance, set industry benchmarks, and inspire and invent solutions to tackle global transformations.

Since 1864, our Purpose has been to safeguard life, property and the environment.

Our experts work right across the hydrogen value chain, from production through transport to end-use. We understand the technical properties of hydrogen, and work with the networks and a wide range of other organisations to identify the key actions needed to roll-out low carbon hydrogen at scale.

This Hydrogen Network Plan, being delivered by DNV GL, sits within the Gas Goes Green Programme and describes how a viable pathway to 100% hydrogen – alongside other decarbonisation solutions – can be delivered practically.

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EXECUTIVE SUMMARY

This detailed and practical plan sets out how Britain's gas network companies will fulfil their commitment to transition the country's gas networks away from delivering natural gas to delivering hydrogen instead. As such, it provides a roadmap for how Britain's five gas network companies will fulfil their commitment to help the UK meet its hydrogen ambitions, including those set out in the Prime Minister's November 2020 Ten Point Plan for a Green Industrial Revolution. That includes how gas network companies will progress to be ready to start blending up to 20% hydrogen into the gas grid by 2023 and how they will help deliver the UK's first 'Hydrogen Town' by 2030.

It shows how this transition will enable Britain to decarbonise 'hard to reach' sectors such as industry, heavy transport and domestic heating, integrating higher volumes of renewable electricity generation and saving an estimated 41 million tonnes of CO2 a year – eliminating around 12% of the UK's total CO2 emissions as we move towards net zero.

It sets out the projects that gas networks will, with regulatory approval, carry out to enable 100% hydrogen to be transported for use in different sectors, identifies the wider actions needed to provide sufficient hydrogen production and storage, and highlights the remaining policy gaps that need to be filled.

Conversion of much of the overall gas network to hydrogen is the best way to allow hydrogen to reach all the users who will need it. A full role for hydrogen in decarbonisation is estimated to create 195,000 jobs overall, of which 75,000 jobs and £18 billion of economic value added would be created by 2035, supporting the UK's post-Covid recovery.

The plan meets the need for hydrogen set out in ENA's previous Pathways to Net Zero report. It has been developed following extensive stakeholder consultation, including workshops and interviews, to understand the key barriers and opportunities for different sectors, and the role for gas networks.

This Executive Summary describes our plan to deliver the network elements of a hydrogen transformation. The required capacity of hydrogen is large, and the networks are prepared to transport and deliver it. This Executive Summary has two parts:

PLAN: The projects to deliver the world's first extensive 100% hydrogen network, the wider actions to enable a hydrogen transformation, and the policy gaps that need to be filled.

BENEFITS: Why hydrogen transported through gas networks is needed to reach net zero in the hard-to-decarbonise sectors and the associated emissions reduction and economic benefits.

As we set out below, the task is major, but achievable. But there is no time to waste – ambition must be turned into action at all levels.

Please note that all references are provided in the main report.

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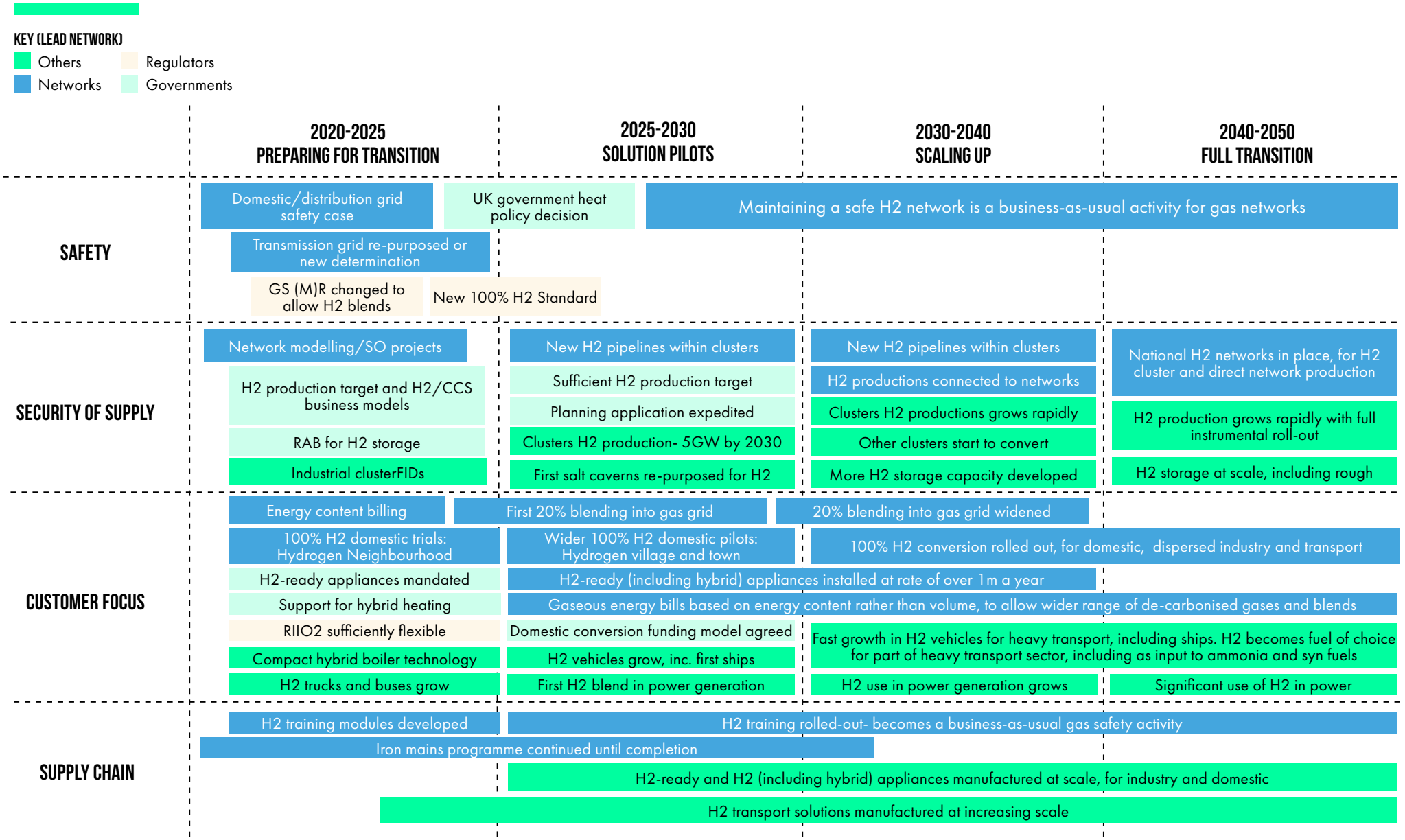
DELIVERING BRITAIN'S HYDROGEN NETWORK PLAN



PLAN: DELIVERING A HYDROGEN CONVERSION IN PRACTICE

THE HYDROGEN NETWORK PLAN WILL BE DELIVERED IN FOUR BROAD STAGES:

• Over the next five years, we will be preparing for transition, including continuing the Iron Mains Risk Reduction Programme, completing the safety case, trialling 100% hydrogen in homes, and carrying out network modelling to ensure that security of supply can be maintained. This first stage will give government the information required to make policy decisions on the conversion of networks.

• From 2025-30, we will be carrying out solution pilots, including larger 100% hydrogen domestic pilots; 20% blending in parts of the network; and billing on the basis of energy content rather than volume. The iron mains replacement programme will also continue.

• In the 2030s, we will scale up, building new using hydrogen pipelines between industrial clusters and to connect with storage facilities; connecting hydrogen production to the networks; and, with the iron mains replacement programme completed, rolling out 100% hydrogen conversion for use in homes, dispersed industry and transport.

• In the 2040s, the full transition will occur, with a national hydrogen network in place and hydrogen a normal part of training for Gas Safe engineers.

TENETS

To deliver a 100% hydrogen network, our plan has four key tenets:

SAFETY

Ensuring people's safety: Working closely with the Health & Safety Executive, our innovation projects are making great progress and results have shown that using hydrogen in the natural gas grid is fundamentally safe. Our safety work is developing the right technology and procedures across the GB system, including:
o End-user appliances, such as domestic boilers and industrial burners;
o The low-pressure distribution network;
o The high-pressure transmission network.

SECURITY

Maintaining security of supply: We will deliver a hydrogen network that meets the same high levels of supply security as today, with very rare unplanned interruptions. This includes ensuring:
o Sufficient physical network capacity and resilience to meet demand peaks;
o Effective System Operation;
o Linkages to sufficient hydrogen production and storage capacity;
o Flexibility to connect new sources at more entry points.

CUSTOMERS

Focussing on people's needs: Our hydrogen network will have a strong customer focus, supporting consumers to decarbonise in a convenient and cost-effective way, including through interim steps to enable rapid decarbonisation, covering:
o Domestic convenience and utility;
o Transport sector convenience and utility;
o Industrial sector convenience and utility;
o Interim steps to reduce emissions rapidly and early, including blending and hybrid heating systems;
o Energy-content billing.

SUPPLY CHAIN

Delivering jobs and investment: We will deliver the supply chain to construct and convert the network needed to allow 100% hydrogen to be introduced on time, which includes:
o Equipment, including appliances and long-lead items;
o Skilled people.

The plan sets out to achieve the hydrogen transformation of the network according to these principles, with the networks having projects planned and underway across the country to deliver this. These projects are detailed in the main report.

WIDER ACTIONS NEEDED

Alongside the preparation of gas networks for hydrogen conversion, a set of wider actions are needed for hydrogen to be adopted at scale. These are outside of the networks' control, although projects are being supported by the gas network operators. Building on the Ten Point Plan, the Government's Hydrogen Strategy needs to support work in several areas, to enable Britain's Hydrogen Network Plan – the wider actions are spelt out in detail in the main report, and the key areas include:

HYDROGEN PRODUCTION:

There must be sufficient hydrogen production for a widespread gas network conversion to take place from 2030, which means that production must be expanded beyond the level that is needed for use within clusters. As explained above, this requires GW-scale capacity additions each year, together with the required low carbon electricity generation and/or natural gas and CCS capacity.

HYDROGEN STORAGE:

Alongside sufficient natural gas storage, hydrogen storage capacity needs to be expanded at the level of several hundred GWh per year from 2025. This cannot be solely at the expense of natural gas storage – inevitably some existing storage facilities will be converted to hydrogen, but other facilities must be newly built, to ensure that the methane network maintains its very high reliability.

CCS:

Ensuring that CCS is developed at scale in several clusters by 2030 is critical to network conversion to hydrogen, as it can deliver more hydrogen more quickly than relying on green hydrogen alone. Over time, green will become the production method of choice, as costs decline rapidly, but in the interim, blue hydrogen can deliver the required scale.

POLICY ACTIONS NEEDED TO DELIVER THIS PLAN

Policy support and decisions from government are required for hydrogen development in all sectors. Significant progress is being made, including ongoing work to develop business models for low carbon hydrogen production, but there are several gaps in policy. These gaps need to be addressed in the forthcoming Hydrogen Strategy to deliver on the commitments made in the Ten Point Plan and to deliver this Network Plan – these are set out in more detail in the main report, and the key points include:

HYDROGEN-READY APPLIANCES:

There is no timetable for mandating hydrogen-ready appliances, which are necessary in order to facilitate a network conversion. The earlier hydrogen-ready appliances are rolled out, the smoother the conversion will be. A mandate needs to be in force by no later than 2025, which would mean that most homes would have hydrogen-ready appliances by 2040.

HYBRIDS:

Hybrid heating systems should be supported now, for roll-out at scale.

HYDROGEN PRODUCTION VOLUMES:

The main risk is that insufficient volumes of hydrogen production are supported. As we set out above, GW-scale production capacity needs to be added each year, and business models need to support this scale. While the Ten Point Plan targets 5 GW of low-carbon hydrogen production capacity by 2030 this needs to be increased to 10 GW to enable this Plan.

STORAGE AND CONVERSION SUPPORT:

There are no business models for hydrogen storage or for network conversion, both of which could be funded through the regulated asset base (RAB) framework. A RAB for hydrogen storage should be in place from 2025, and for domestic conversion from 2030.

FLEXIBILITY:

The RIIO2 framework needs to be managed in a sufficiently supportive and flexible way to enable the range of innovation projects and trials to be carried out in a timely way.

PLANNING:

The planning system will need to be able to accommodate a large volume of applications for hydrogen production, storage, pipeline and other facilities. It is not clear whether the planning system will be able to manage this in a timely manner. Planning applications should be prioritised and decisions expedited.

DELIVERY

As we have shown in our time line graphic and description above, delivering our Hydrogen Network Plan requires action on the part of networks, government, regulators and others over the coming years.

BENEFITS: THE EMISSIONS REDUCTION AND ECONOMIC BENEFITS

TACKLING THE HARD-TO-DECARBONISE SECTORS

Hydrogen can make a major contribution to meeting net zero in the hard to decarbonise sectors – domestic heating, heavy transport, and industry – where combined emissions are around 180 million tonnes, 40% of the UK total.

Hydrogen can also help accommodate the growth of renewable electricity, with wind and solar power being used to produce hydrogen, and then the hydrogen being used in a power station to produce electricity during periods when wind and solar generation are low, or stored for use in the gas networks.

As set out in the recent ENA Pathways to Net Zero report, a balanced decarbonisation solution that includes a significant role for hydrogen transformation, alongside biogases and electrification, is the most cost-effective way to decarbonise, saving £13 billion a year when compared with a fully electrified alternative.

REACHING ALL POTENTIAL HYDROGEN USERS

The key benefit of gas network conversion to hydrogen is that it is by far the lowest cost and largest scale way of transporting the hydrogen from where it is produced to the dispersed industrial, domestic and transport users who will need it to decarbonise:

Dispersed users: Dispersed industry accounts for over half of industrial emissions, and gas networks will be needed to transport hydrogen to these facilities. BEIS figures show that the UK's six main industrial clusters have combined emissions of around 33 million tonnes of CO2. But overall industrial emissions are more than twice that, at 76.5 million tonnes.

Cost and feasibility: It is simply not possible to put a hydrogen production unit at the end of every street, or beside every commercial or small industrial building, and nor is it feasible to load 236 TWh of hydrogen onto tankers to drive around the country – the larger road tankers can carry 600kg of hydrogen, or about 23 MWh, so around 10 million tanker loads would be needed.

REDUCING EMISSIONS

Based on hydrogen replacing natural gas in buildings, industry and power generation, and replacing oil products in surface transport and shipping, we conservatively estimate that hydrogen will lead to emissions savings of between 30 million and 105 million tonnes of CO2, depending on the level of hydrogen adoption in the various scenarios put forward by the Committee on Climate Change, National Grid and Aurora. For the level of hydrogen use in ENA's Pathways to Net Zero report, around 41 million tonnes of CO2 would be saved – eliminating around 12% of the UK's total CO2 emissions as we move towards net zero. (Our methodology is explained in full in the main body of the report.)

CREATING JOBS AND ECONOMIC GROWTH

The overall job creation benefits from cross-sectoral hydrogen deployment are large, supporting the UK's post-Covid economic recovery and helping the UK to build back better, right across the country:

- Through to 2050, hydrogen and CCS development for broad based decarbonisation could create 43,000 jobs for industrial decarbonisation alone, 195,000 jobs if hydrogen plays a full role in economy-wide decarbonisation, and 221,000 jobs if the UK also becomes a major hydrogen exporter.
- By 2035, a recent analysis by the Hydrogen Task Force estimated that 75,000 jobs could be created overall, together with £18 billion of GVA, from around 125 TWh of hydrogen. This would include 26,600 jobs in hydrogen production alone, with 12,542 jobs in electrolyser manufacturing and 10,482 jobs in auto thermal reforming.

The economic benefits and protection and creation of jobs are most likely to be felt in less affluent parts of the country, where industry and hydrogen production would be concentrated. Overall, energy intensive industry accounts for £140 billion in economic value added and employs over 1.1 million people.