

ENGINEERING A SUSTAINABLE GAS FUTURE

IGEM Policy Paper
November 2021



About IGEM

The Institution of Gas Engineers & Managers (IGEM) is the UK's Professional Engineering Institution, supporting individuals and businesses working in the global gas industry. IGEM was founded in 1863 with the purpose of advancing the science and relevant knowledge of gas engineering for the benefit of the public.

As a not-for-profit, independent organisation IGEM acts as a trusted source of technical information, guidance and services for the gas sector. In today's net zero context, IGEM is focused on engineering a sustainable gas future – we do this by:

- Helping our members achieve and uphold the highest standards of professional competence to ensure the safety of the public
- Supporting our members in achieving their career goals by providing high quality products, services and personal and professional development opportunities
- Acting as the voice of the gas industry when working with stakeholders to develop and improve gas policy

UK gas policy landscape

There is growing global concern over greenhouse gas emissions caused by human activity, with many governments, scientific and environmental groups declaring a climate emergency. In 2019, the UK Government made a legal commitment to reduce its carbon emissions to net zero by 2050, with the Scottish Government committing to net zero by 2045 and the Welsh Government committing to net zero by 2050, but with ambition to get there sooner. By doing so, the UK became the first major economy to pass a net zero carbon emissions law and demonstrated its global leadership in the fight to curb the effects of climate change – pursuing efforts to keep global warming to less than 1.5 degrees by 2100, in accordance with United Nations climate goals and the 2015 Paris Agreement¹.

The UK's independent adviser on tackling climate change, the Climate Change Committee (CCC), is instrumental in shaping how the UK can achieve net zero and informing the strategy and policies to support the transition. In its Sixth Carbon Budget, the CCC outlined a range of recommendations based on its 'Balanced Pathway' scenario, which includes a balanced mix of net zero measures across demand-side actions, hydrogen, electrification and natural and engineered greenhouse gas removals². In its recently published Progress Report to Parliament³, assessing the UK's progress in reducing emissions and adapting to climate change, the CCC acknowledged the historic climate promises made by the UK Government over the past year, but states that it has been "too slow to follow these with delivery".

¹ United Nations Framework Convention on Climate Change - <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/key-aspects-of-the-paris-agreement>

² The Climate Change Committee, [The Sixth Carbon Budget: The UK's Path to Net Zero](#), December 2020

³ The Climate Change Committee, [2021 Progress Report to Parliament](#), June 2021

The UK Government has recently published a suite of documents that set out its strategy to decarbonise the energy system and tackle climate change; the Ten Point Plan for a Green Industrial Revolution, the Energy White Paper, the UK Hydrogen Strategy, the Heat and Buildings Strategy and the Net Zero Strategy. The measures set out in the Energy White Paper are estimated to reduce carbon emissions across power, industry and buildings by up to 230MtCO₂e in the period to 2032 (compared to 451MtCO₂e in 2018), and in delivering this, support up to 220,000 jobs per year by 2030.

Alongside investment in areas such as offshore wind, heat pump installation, Carbon Capture Utilisation & Storage (CCUS) and the development of industrial clusters, there are promising commitments made to hydrogen, with government analysis suggesting that a third of the UK's energy consumption could be hydrogen-based by 2050. Key commitments include a target of 5GW of low carbon hydrogen production capacity by 2030, equivalent to the amount of gas consumed by over 3 million households in the UK each year, and aiming for 1GW by 2025 (embracing both electrolytic and carbon capture enabled methods that can both achieve a net zero outcome), a £240 million Net Zero Hydrogen Fund, an ongoing commitment to hydrogen heating trials and a scaling up of hydrogen infrastructure for the development of a Hydrogen Neighbourhood by 2023, a large Hydrogen Village by 2025 and a Hydrogen Town by 2030. IGEM welcomes the UK government's acknowledgement that there is a need for further hydrogen research, changes to gas quality regulations and investment in the gas network to enable this to happen.

The UK aims to be a world leader in decarbonising industry with the development of industrial clusters across the UK. These regional concentrations of industries and economic activity will drive the decarbonisation of energy intensive sectors, including iron and steel, chemical and textile production, and transform them into low carbon manufacturing hubs. This will drive global investment and create internal markets for low carbon technologies, including hydrogen. The hydrogen produced in these industrial clusters can be used for flexible power generation, transport and heat applications.

More recently, the UK Government announced a new, more challenging target to reduce the UK's emissions by at least 68% by 2030, compared to 1990 levels and builds on this goal to achieve a 78% reduction by 2035. IGEM welcomes this more ambitious target, which is aligned with the recommendations set out by the CCC, and demonstrates the UK's leadership as part of the November 2021 UN COP26 climate summit hosted by the UK Government. But to achieve these more challenging targets, government and industry must act with urgency.

IGEM sees the potential for increased biomethane injection, hydrogen blending and hydrogen for transport all offering a meaningful contribution to the UK's 2030 target.

In terms of current low carbon gas supplies to the network, the UK Government has reaffirmed its commitment to increase the proportion of biomethane injected into the gas grid and to accelerate the decarbonisation of gas supplies, with the expectation of trebling the amount of biomethane in the grid between 2018 and 2030 - supported by the Green Gas Support Scheme that replaces the Renewable Heat Incentive. Quickly ramping up production will allow more biomethane to be injected into the gas grid for heating and use in trucks, while additional low carbon options are being developed and scaled up.

HyDeploy⁴, funded by Ofgem and led by Cadent and Northern Gas Networks, is the UK's first pilot project to inject zero carbon hydrogen into the gas network. The project is exploring the potential for safely blending up to 20% hydrogen into the current gas supply. Enabling hydrogen blending to be widespread across the gas network will provide a valuable contribution to carbon emissions in the short term, with the potential to deliver up to 7% emissions reduction from the grid⁵.

The use of hydrogen in transportation is growing steadily. Currently there are over 140 hydrogen fuel cell vehicles in the UK, including cars, buses, trucks and trains, and the deployment of the UK hydrogen mobility programme could see this rise to 6,000 by 2025⁶. The UK Government recognises the potential for hydrogen to deliver zero emissions technology for transport and have recently announced projects for zero emission road freight trials and hydrogen transport pilots.

Decarbonising heat

An extensive gas grid, comprising 7,600km of transmission pipelines and 284,000km of distribution pipelines, currently supplies natural gas and a small proportion of biomethane across the UK.

Approximately 85% of UK households use natural gas for heating, equating to more than 24 million homes and businesses⁷. The natural gas that is burned at the point of use, such as in boilers and cookers, produces carbon emissions.

Although natural gas has helped reduce UK carbon emissions significantly by displacing coal and oil (which produce double the CO₂ emissions of natural gas)⁸, it is still a major contributor to UK CO₂ emissions. With heating now accounting for 37% of the UK's carbon emissions⁹, decarbonising heat across domestic, commercial and industrial uses is one of the toughest challenges facing UK climate policy makers today.

There are various potential solutions for low carbon heating. Those with the potential to play a significant role in decarbonising heat include hydrogen, biomethane, heat networks, heat pumps and hybrid heating systems.

⁴ <https://hydeploy.co.uk/>

⁵ HM Government, [Heat and Buildings Strategy](#), October 2021

⁶ UK H2 Mobility, [Accelerate H2: A hydrogen mobility strategy for the early 2020s](#), July 2020

⁷ Department for Business, Energy & Industrial Strategy, [Clean Growth – Transforming Heating: Overview of Current Evidence](#), December 2018

⁸ Institution of Engineering and Technology, [Transitioning to Hydrogen: Assessing the Engineering Risks and Uncertainties](#), June 2016

⁹ Energy Systems Catapult, [Decarbonisation of Heat: Why it Needs Innovation](#), March 2020

IGEM supports proposals to use the existing network of gas pipelines to carry low carbon gases, such as biomethane and hydrogen blends, working towards the eventual use of 100% hydrogen. Crucially, hydrogen produces zero carbon at the point of use and forms the basis of the gas industry's proposed pathway to a sustainable gas future. Evidence is also pointing to significantly reduced NOx emissions from hydrogen boilers, compared to the most modern natural gas boilers on the market today¹⁰.

Using electrified technologies such as heat pumps, powered using renewable electricity, is a strategy that the UK Government has already embraced as a way of making near term reductions in carbon emissions. This approach will put significant additional strain on electricity capacity, and it is scarcely recognised that additional electricity demand is increasingly being accommodated by generation from reciprocating gas engines. Electricity generation from gas today flexibly ranges from 7-70% of the mix at any one time. The advantage of gas is its ability to balance daily and seasonal demand variations and provide flexibility in electricity supply. In the future, low carbon gas could play an important role in reducing peak demand on the electricity system and increasing the deployment of renewable technologies through new methods, including power to gas and hybridisation of end use technologies involving a combination of electricity and low carbon gases.

The use of heat pumps will require significant additional energy efficiency measures and building retrofit to be effective across the UK. Recent research on decarbonising heat in buildings examines the challenge of retrofitting old housing stock with low carbon heating technologies, stating that heat pump only systems could be unsuitable for up to 54% of the existing UK housing stock¹¹.

Historically, the heat decarbonisation challenge was presented as a choice between large-scale electrification or the utilisation of low carbon gases - each with their own merits and challenges. However more recently, we see growing support for an integrated, 'whole-system' approach to meeting the energy transition challenge, with the UK Government now supporting a portfolio of low carbon technologies and projects, looking across power, gas, heat and transport¹².

The policy approaches to date indicate that the UK Government is keeping its options open; investing in low carbon technologies, R&D and developing the markets to support both electrification of heat and hydrogen for heating. The recently published Heat and Buildings Strategy reiterates its commitment to ramping up heat pump installations and phasing out fossil fuel heating in the near term. Strategic decisions on the implementation of hydrogen for heating are due in 2026, following the outcome of various strands of work, including 100% hydrogen heating trials, hydrogen blending in the existing gas network, consultation on hydrogen-ready boilers, as well as extensive research and testing.

¹⁰ Gersen, S. Darmeveil, H. Van Essen, M. Martinus, G.H. and Teerlingc, O.J, [Domestic hydrogen boilers in practice: enabling the use of hydrogen in the built environment](#), March 2020

¹¹ Energy & Utilities Alliance, [Decarbonising Heat in Buildings: Putting Consumers First](#), April 2021

¹² HM Government, [Energy White Paper: Powering our Net Zero Future](#), December 2020

Regardless of the technologies used to achieve heat decarbonisation, it is imperative that consumers are put at the forefront of the energy transition if we are to reach net zero. The transition is likely to cause disruption to households and require consumer behaviour change, so offering consumer choice and ensuring they are closely consulted and supported throughout the journey will be key to its success. Crucially, the energy transition must ensure that low income households and vulnerable consumers do not disproportionately bear the cost of low carbon energy policies, messaging echoed in the Heat and Buildings Strategy. The Government must now deliver on its commitment to put consumer welfare and choice at the heart of the transition.

What is IGEM's contribution?

Supporting the gas industry and our members

IGEM members, and the engineering community as a whole, are at the forefront of making a sustainable gas future a reality – IGEM is dedicated to supporting them to achieve this. The intrinsic value of IGEM as a Professional Engineering Institution (PEI) lies embedded within its membership; to provide opportunities for UK based and international members to come together, share knowledge, debate and learn from cutting edge developments around the world.

Our individual and company members are actively working together and with partners across the academic, scientific and wider engineering communities, to understand how gas can contribute to a clean energy future. A range of hydrogen feasibility and safety projects are now underway, the results of which are forming the vital evidence base for future gas policy and the development of a decarbonised gas network.

IGEM is supporting initiatives such as 'Gas Goes Green'¹³, which brings together all five of the UK's gas network companies to create the world's first zero carbon gas grid. The initiative aims to speed up the switch from natural gas to a hydrogen and biomethane supply for the 85% of UK households connected to the gas grid. In turn, enabling people to use their heating, hot water and cooking appliances almost exactly as they are used today.

Safety and technical leadership

The UK has an excellent gas safety record and it is critical that we maintain this record throughout the transition to a low carbon gas network. The resilience of the current gas system must also be maintained, where historically, customers experience an unplanned gas outage only once every 140 years¹⁴.

¹³ <https://www.energynetworks.org/creating-tomorrows-networks/gas-goes-green>

¹⁴ Energy Networks Association, [Britain's Hydrogen Network Plan Report](#), January 2021

IGEM will continue to provide technical leadership on gas safety and quality throughout the transition, underpinned by industry technical standards. At the core of IGEM's work lies a formal, robust process for the creation, review and further development of the Technical Standards and guidance documents upon which our gas industry safely runs its operations. This process is strictly governed and supported by IGEM members and technical stakeholders, including industry regulators, and involves industry wide consultations to achieve consensus and ensure best practice. It is this leadership that is enabling the hydrogen demonstrators we see around us today.

IGEM recommends that policy makers adopt low regrets options without delay, to enable the UK to make early, cumulative contributions to carbon emissions reduction, which in turn reduces the need for climate change adaptation investment in the future.

Gas network companies are readying to start blending up to 20% hydrogen into the gas grid by 2023, without the need for any change to consumer appliances¹⁴. Northern Gas Networks have recently announced plans for a 10-month long pilot, starting in 2021, for up to 20% hydrogen blending into the gas network.

For hydrogen blending to pass trial stages, UK regulations need to change. Following extensive technical review and industry-wide consultation, IGEM has drafted a new Gas Quality Standard to support that process. Once approved by the Health and Safety Executive (HSE), this standard will enable a change to the regulations allowing a broader range of gases in the network, including biomethane and blended hydrogen. This change will enable the UK to make near term reductions to the carbon intensity of gas in the network and will form an essential prerequisite to the adoption of hydrogen-ready appliances, such as boilers, in buildings across the UK.

The UK Hydrogen Strategy states the Government's commitment to reviewing the Gas Act 1986 and gas quality standards to allow for decarbonised gases, such as hydrogen, into the network. This will include a Call for Evidence on the future of the gas system, calling on expertise throughout the energy system on the future role of gas. The Government will complete an assessment of the value for money case for blending up to 20% hydrogen into gas networks in 2022 with the aim to have a final policy decision in late 2023.

IGEM supports the recommendation outlined in the Gas Goes Green 'Britain's Hydrogen Network Plan' report, that a hydrogen-ready appliance mandate be in force by no later than 2025, meaning that most homes would have hydrogen-ready appliances by 2040. Mandating hydrogen-ready appliances, such as boilers, from 2025 would ensure a smoother and quicker switchover to hydrogen once the gas grid is ready and regulations have been updated. However, the recent Government commitment in the Hydrogen Strategy is to consult in late 2021 on hydrogen ready boilers being in force by 2026.

IGEM acknowledge that to progress at speed, the industry must demonstrate the efficacy and safety of hydrogen, evidenced through rigorous testing and trials. The UK Government is supportive of this process and is progressing plans for a number of unoccupied and occupied trials using hydrogen – first hydrogen homes, and later phasing up to small residential trials¹⁵. In an open letter from Government, gas distribution networks have been invited to deliver proposals to support the development and delivery of a hydrogen village trial¹⁶. Appliance manufacturers have also stepped up to the challenge, successfully demonstrating that hydrogen-ready boilers can be safely operated using a blend of hydrogen and natural gas or biomethane, and can be adjusted to receive a 100% hydrogen supply in around half an hour.

IGEM are leading on a range of activities to support the delivery of these trials and demonstrations, as part of R&D programmes such as Hy4Heat, and stand ready to support transition activities within industrial clusters, electricity generation and transport sectors - providing pioneering projects with expertise in fuel switching to hydrogen and incorporating the latest developments in hydrogen safety, technical standards and processes.

IGEM was commissioned to develop the UK's first technical standard for the use of low-pressure hydrogen, discussing the scientific principles required for the safety and integrity of hydrogen installation and utilisation in premises¹⁷. This technical standard was delivered in 2020.

A further initiative is the development of hydrogen technical standards for the high-pressure transmission and lower-pressure tier distribution networks. IGEM commissioned this work under the HyTechnical programme, developing standards to support both new and repurposed networks for hydrogen.

IGEM is also developing a new standard for hazardous area classification, for permanent and temporary hydrogen gas installations – providing a basis for the correct selection and location of fixed electrical equipment in those areas. This standard will be a key enabler for the design work required for hydrogen community trials and large-scale network changeovers.

IGEM's authoritative technical work also directly supports the use of other gases that will help decarbonise the energy system, such as the growing number of biomethane connections to the gas grid, and Compressed Natural Gas (CNG) for transport applications.

¹⁵ HM Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020

¹⁶ Ofgem, [Hydrogen Consumer Trial - Open Letter to GDNs](#), July 2021

¹⁷ [Hy4Heat, Work Package 2](#)

Knowledge sharing

Although the UK Government's pathway to heat decarbonisation includes approaches that are dependent on research outcomes, what is certain is that the energy system will undergo a profound transformation in the decades to come. Throughout this change, it is imperative that the gas engineering community builds the capability for delivering net zero and that supporting institutions, such as IGEM, provide a platform for them to collaborate, knowledge share and provide access to emerging technical knowledge.

An enabling tool for knowledge sharing is IGEM's Hydrogen Knowledge Centre¹⁸ - a world class digital repository, dedicated to the advancement of hydrogen learning globally. It provides a centralised, searchable library of hydrogen related resources across the full range of hydrogen technologies and applications. We add resources daily and plan to extend the Hydrogen Knowledge Centre to capture all the learning and developments from upcoming 100% hydrogen demonstrators - with the ambition to develop a digital hydrogen conversion manual to guide the sector through the transition to 2050.

IGEM continues to bring engineers, managers and stakeholders together through a programme of technical and policy events each year - these include contributions from government ministers, regulators and experts across engineering and energy policy.

Skills development

The delivery of a new, low carbon energy system reliant upon hydrogen will require a reskilled and upskilled technical workforce that can competently handle a broader range of technologies than those existing today. The UK Hydrogen Strategy predicts that a successful hydrogen sector could support 9,000 direct jobs in the UK by 2030 and up to 100,000 by 2050. To support this, IGEM is playing a leading role in the following key areas:

- Development of a new hydrogen training specification for skills partners, to ensure that a competency-based hydrogen training programme can be created and deployed through a UK-wide industry approved framework. This will ensure that the supply of apprentices, gas technologists and operatives are competent to work with hydrogen and safely install hydrogen-ready appliances.
- Audit and approval of 'authorised training provider organisations', particularly crucial during the implementation of new hydrogen curricula.
- Enhancing peer-based professional competency review processes, so that high quality gas engineers with knowledge and competence in handling engineering aspects of decarbonised gases can be professionally registered.
- There is a clear demand for high quality training on net zero in a whole energy system and hydrogen fundamentals from both engineers and company managers, whose businesses will ultimately have to embrace hydrogen and the new roles and skills that the transition will bring. IGEM is serving this need by routinely delivering accredited hydrogen courses for the sector. We also have ambitions to soon be delivering net zero energy system training (highlighting the role of gas across heat, power, transport and industry) for those working in a range of different fields, such as customer services, finance, manufacturing and asset management.

¹⁸ www.h2knowledgecentre.com

The decarbonisation challenge is complex, and IGEM recognises that value can be maximised through collaboration with government, industry initiatives such as ‘Gas Goes Green’ and the broad science and engineering community.

We also recognise that a sustainable gas future will require a careful balance across environmental, economic and social pillars and that consumers must be at the heart of the energy transition. The engineering community must support a fair transition to heat decarbonisation – one that is safe, affordable, secure and accessible to all consumers. Research sponsored by IGEM, demonstrates that the principles of fairness and equity must be built into all aspects of the transition to low carbon heat¹⁹ and that fuel poverty must be properly addressed as part of a ‘just transition’²⁰.

Through ambitious leadership, strong government-industry collaboration, greater R&D investment and policy support, the UK could be one of the leading decarbonised economies in the world. In doing so, the UK will benefit from economic and export growth, skills and job growth, greater productivity and energy security.

IGEM is proud to be supporting the UK gas industry in stepping up to the net zero imperative – to explore sustainable, safe and affordable solutions for decarbonising heat and other end uses, and support the UK’s climate goals for the benefit of future generations.

¹⁹ Carbon Connect, [Pipeline to 2050 - Building the Foundations for a Harmonised Heat Strategy](#), November 2020

²⁰ Carbon Connect, [Uncomfortable Home Truths - Why Britain Urgently Needs a Low Carbon Heat Strategy](#) [Future Gas Series Part 3](#), November 2019



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