HyDeploy2 Project

Gas Network Innovation Competition // Cadent

5th Project Progress Report (PPR) // January 2024

The HyDeploy2 project seeks to address a key issue for UK energy customers: how to reduce the carbon they emit in heating their homes. The UK has a world class gas grid delivering heat conveniently and safely to more than 83% of homes. Emissions can be reduced by lowering the carbon content of gas through blending with hydrogen. This delivers carbon savings, without customers requiring disruptive and expensive changes in their homes. It also provides the platform for deeper carbon savings by enabling wider adoption of hydrogen across the energy system.

This Network Innovation Competition (NIC) funded project sought to develop the safety evidence base to allow roll-out of a 20% blend of hydrogen (by volume) within the UK gas distribution network by running industrial trials, conducting social science research, and delivering public network demonstrations.

Following completion of the safety evidence, government will take a future decision on whether to enable blending which will include the consideration of any implications to from the safety assessment. The safety assessment will involve a review of the evidence by the Health and Safety Executive (HSE). Enabling blending at scale will require amendments to legislation, including Gas Safety (Management) Regulations (GS(M)R), 1996, which currently limits the hydrogen content within existing gas distribution networks to 0,1% mol. These regulations ensure the safe use and management of gas through the gas network in the UK. If the outcomes from the safety review and subsequent economic assessment support a future decision for hydrogen blending, government will then look to start the legislative process to implement amendments.

Blending hydrogen at 20 mol% with natural gas across the UK, would save around 6 million tonnes of carbon dioxide emissions every year, the equivalent of removing 2.5 million cars from the road.

Contents

1.0 Executive summary

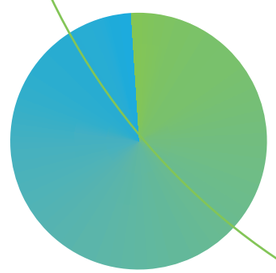
In December 2023, the Department of Energy Security and Net Zero (DESNZ) made a significant decision on hydrogen blending, explicitly referencing the foundational work conducted to date by the HyDeploy project. This decision not only acknowledges the pivotal role of the project but also underlines its strategic importance in supporting the development of the wider hydrogen economy in Great Britain (GB). The outputs of HyDeploy provide benefits beyond the borders of the UK with many nations currently exploring the potential to blend hydrogen into their existing gas supply. Blending has been noted to provide key strategic benefits such as unlocking rapid build out of hydrogen production by acting as offtake resilience as well as being a strategic enabler for key production projects. Government has alluded to the need to evaluate and review the safety evidence produced by HyDeploy to finalise the decision on blending at scale.

The commitment to safety and thorough evidence development throughout the project have been exemplary and this is personified in the safety evidence reports produced for the two successful exemption decisions at the locations of Keele and Winlaton. The direction of the project shifted in 2021 to allow a focus on the development of a national case for safety. Over the last year the efforts to achieve this objective have intensified and can be better understood through the progress of key technical workstream. An extensive materials and assets programme has led to the creation of a GB wide register which is informed by key data inputs from gas networks and a review of existing standards. This list is taken forward into an assessment methodology to assess these assets against their use in hydrogen blends. Rigorous research and development on shortlisted assets have ensured comprehensive evidence is produced on the suitability assessment.

To ensure the previous evidence is transferable to wide scale roll out, the project has extended its safety considerations in all areas of its existing evidence. An extension to pre-1976 appliances was undertaken for the domestic user base. Further technical research was conducted on high pressure (HP) systems and the risks associated with them. This expansion ensures a thorough review on compliance with existing standards and procedures also undertaken. HyDeploy continues to develop its evidence on the industrial and commercial (I&C) sector. A review of I&C has culminated in the creation of case studies. These case studies are designed to guide industry in their transition to hydrogen blends, offering insights into the practical aspects of implementation. To inform the case studies, further work has been commissioned with expert contractors on identifying the safety impacts to key industrial users such as gas engines, turbines, compressors, and chemical feedstocks. This ensures a complete review can be undertaken and a representative approach can be implemented through the case studies.

Throughout the duration of the project, effective communication and engagement has been central to the success of the project. A variety of communication methods including delivery of presentations, videos, reports, surveys, and online content, have allowed the projects findings and implications to be shared more widely. In September 2023, HyDeploy released a podcast alongside Xoserve titled ‘A conversation about HyDeploy’ in which key learnings and technical outputs were discussed. Following the Winlaton trial, HyDeploy continued to engage with consumers in the trial area, gathering data from 130 surveys. The results of the research suggested that generally, respondents would support hydrogen use in the home, and initial safety concerns can be alleviated through clear and robust communication.

In summary, 2023 has been another year of significant advancement for the HyDeploy project and hydrogen blending in general. The Government’s strategic decision in December 2023 for hydrogen blending is a critical step on the road to enabling blending at scale. The project has pushed the boundary on the level and quality of technical evidence being produced to support hydrogen blending and has also complimented this with successful stakeholder engagement at all levels. The project is now focussed on finalising the safety evidence submission to the Health and Safety Executive (HSE) in 2024, which will bring together the last seven years of research and development to help deliver hydrogen blending at scale.



The outputs of HyDeploy provide benefits beyond the borders of the UK with many nations currently exploring the potential to blend hydrogen into their existing gas supply.

2.0 Project manager's report

The HyDeploy2 project has had a successful year, developing the safety evidence for rolling out hydrogen blended gas networks across GB culminating in a positive strategic policy decision for hydrogen blending.

Key achievements

The key achievement of 2023 was the strategic policy decision by government, which stated that based on current evidence, there is potential strategic and economic value in supporting the blending of up to 20% hydrogen (by volume) into the GB gas distribution networks. Government support for blending aims to reduce production and system cost whilst facilitating the growth of the hydrogen economy. The key feature of this decision was that it propelled government's proposal for the Hydrogen Production Business Model (HPBM) to be the primary mechanism to provide any subsidy support necessary for volumes that are blended.

HyDeploy has worked meticulously with government and the HSE over the past 12 months. Data and information for previous successful industrial trials and public demonstrations as well as test data and other evidence to demonstrate how blending can be used safely in the GB gas distribution networks (GDNs), has been provided to the government. Whilst in parallel, the focus remains on completing and compiling the evidence base for GB wide roll-out of hydrogen blending in GDNs, which will be submitted to the HSE and government to review and ultimately support any decisions on implementation such as amendments to GS(M)R.

Cross programme collaboration has been a particular achievement driven by HyDeploy. The increase in hydrogen research programmes generated the risk of duplication and misalignment. HyDeploy was keen to ensure that resources were spent efficiently, particularly in materials testing as it can be a resource heavy field. A cross industry materials working group was established via the Energy Networks Association (ENA) whereby all GDNs developed evidence regarding the suitability of materials and assets to be repurposed for hydrogen, all GDNs were informed of all programmes, schedules, results and conclusions – this collaborative approach has been a key achievement.

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Communications and dissemination

The project team has prioritised regular and informative communication since the start of the project. This has been coupled with targeted strategies for disseminating project findings and promoting collaboration. Various channels have been used to reach a diverse audience such as in person and online presentations, written publications, podcasts, stakeholder engagement sessions and informative video releases.

This year HyDeploy has conducted numerous presentations at a variety of industry events and recorded a podcast with Xoserve to bring forward the key insights and technical findings. The team has focussed on communication with relevant stakeholders to ensure they are well informed and has had key input into the Government strategic decision on blending.

Following the successful completion of the Winlaton Trial in the August 2022, the Winlaton Trial Report was launched at an event held in the House of Lords in the Autumn of 2022. The event comprised of key note speeches from Lord McNicol of West Kilbride and senior members of the leadership teams from Cadent and NGN. The project team shared the progress to date and rounded off with a multidisciplinary panel discussion addressing the challenges and highlighting opportunities that hydrogen blended networks have to offer. The event was well attended by Ofgem and Government officials as well as a local resident from the Winlaton Trial who was able to share their first-hand experience of using hydrogen blended gas within their home.

NGN's Low Thornley site (the location of the hydrogen blend compound and injection units) had opened its gates in 2021 for site visits and continued to host visits throughout 2022. These visits were well attended - seeing several residents from the Winlaton trial network attend as well as wider industry leaders and Government officials.

Outlook for next period

In December 2023, DESNZ confirmed their strategic decision to proceed with hydrogen blending through the release of their report, Hydrogen Blending into GB Gas Distribution Networks[1]. This decision will be further evaluated following the review of the safety evidence being generated by HyDeploy 2. The HyDeploy 2 Programme has been developing evidence to cover the full GB gas distribution system and has aligned this work to the published HSE safety assurance protocol; a document produced to provide guidance on the safety considerations during the development of a hydrogen trial. HyDeploy is in the process of finalising the evidence related to those considerations into eight main reports which will be delivered to the HSE and DESNZ.

In 2024, the reports will be submitted by HyDeploy, for review by the HSE who will subsequently be able to provide DESNZ with their view on whether to proceed with enabling blending at scale.

Key challenges

Hydrogen is becoming more widely recognised as a credible solution to help decarbonise the energy sector in domestic, commercial, and industrial settings. This has led to an increase in hydrogen energy related projects across the supply chain from production and transportation, through to storage and end-use. This increase of research and innovation in the field, although positive for the hydrogen economy, has resulted in resourcing challenges.

The use of hydrogen as a credible low carbon alternative to natural gas is still in its infancy from an operational perspective, and therefore there is a scarcity of subject matter experts in this field, this is further compounded by the rise in demand for these scarce resources. This has led some of the HyDeploy research to be conducted overseas by making use of the consortium's international networks and contacts. This has also meant that a larger number of contractor organisations were procured to be able to 'divide and conquer' the breadth of investigations that was necessary, and although this introduces project management risk, quite helpfully, it provides broader peer review of the evidence being generated and hence increasing the credibility of the conclusions that are being reached. Simultaneously, there has been a large draw on the HSE's time and resource, given the rise in hydrogen research projects developing safety evidence. This has seen a step change in how the HSE have organised themselves to receive evidence for review, this has differed to previous experiences for HyDeploy when applying for exemptions to GS(M)R via safety case submissions. This has meant the project has had to adapt to the way evidence is reported, submitted, and reviewed.

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1. https://assets.publishing.service.gov.uk/media/657a0a82254aaa0010050cde/hydrogen-blending-strategic-policy-decision.pdf

3.0 Business case update

Under the Climate Change Act, as modified in 2019, the UK is committed to achieving Net Zero emissions by 2050. This requires decarbonisation of all aspects of the energy sector. The 2021 Hydrogen Strategy[2] built upon the recommendations from the Committee on Climate Change (CCC)[3] in its Net Zero report.

The UK Hydrogen Strategy is clear that 'developing a thriving low carbon hydrogen sector in the UK is a key plank of the Government's plan to build back better with a cleaner, greener energy system'. It also notes that 'low carbon hydrogen has a critical role to play in our transition to net zero.' The strategy sets out the roadmap to deliver the ambition of 5 GW of production capacity by 2030, which was subsequently increased by the UK Energy Security Bill to 10 GW.

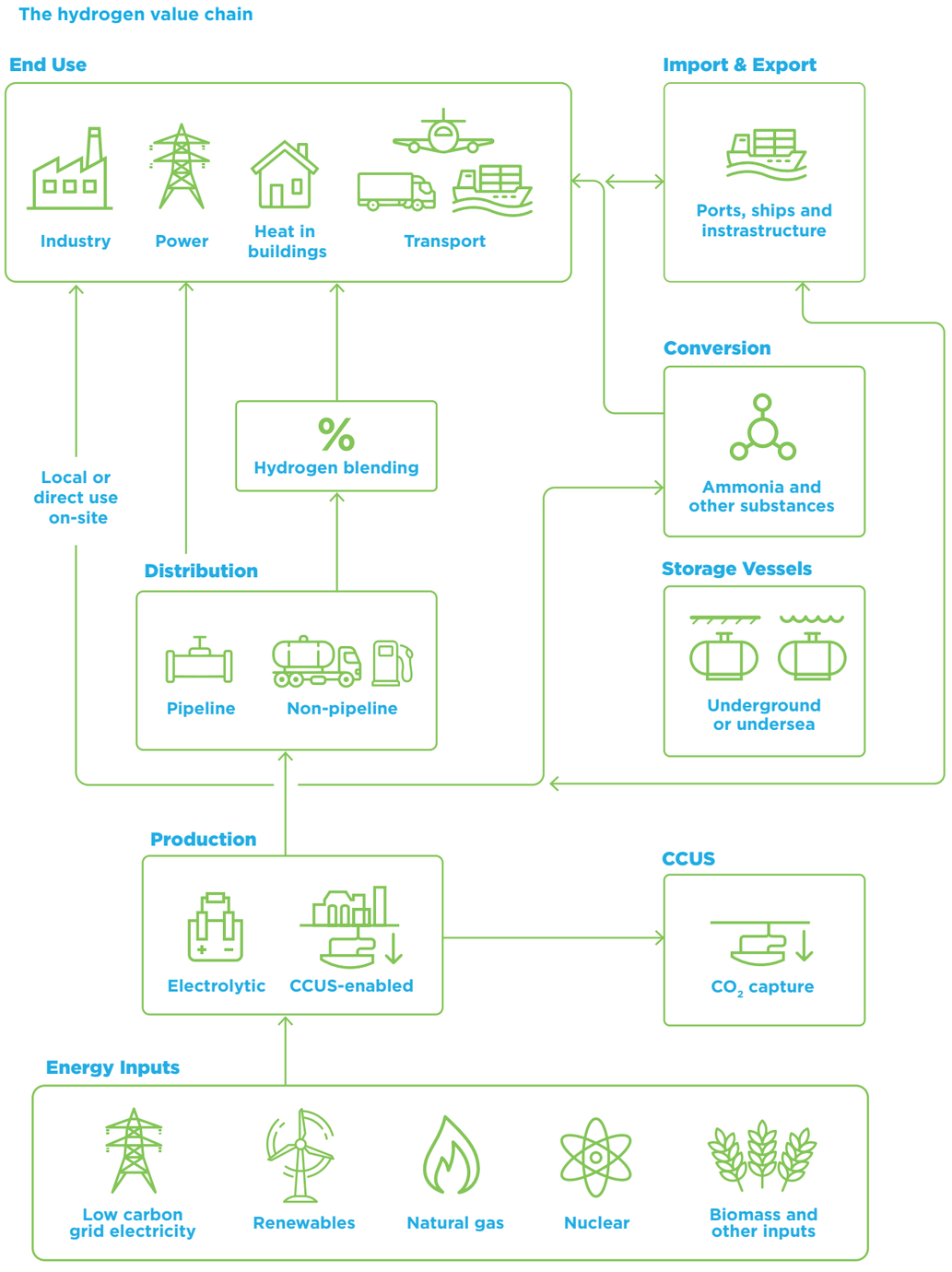
In December 2023, government issued its Hydrogen Strategy Update to the Market[4]. This outlined the progress that has been made across the entire hydrogen sector since 2021. It noted Chris Skidmore's Independent Review of Net Zero[5] and the crucial role hydrogen will play in terms of energy security, economic growth, and net zero, as did the UK's Hydrogen Champion report. The 2023 Committee on Climate Change report, Delivering a reliable decarbonised Power System is clear that hydrogen has an important role in balancing a low carbon electricity grid, providing a fuel for low carbon dispatchable power generation.

The Energy Act 2023 provides the basis for a cleaner, more affordable, and more secure energy system, with key legislative powers to unlock hydrogen production and infrastructure. In September 2023, the UK and Germany signed an agreement to accelerate the development of an international hydrogen industry. The update to the market provided a revised Hydrogen Economy Roadmap underpinning developments and laid out the substantial progress that has been made in announcing the support of 11 electrolytic hydrogen projects. Meanwhile, two large scale CCUS-enabled projects are progressing through to financial investment decisions in 2024 under the Track 1 Cluster Sequencing process.

During this period the business case for hydrogen blending itself has taken a significant step forward, predominantly as part of the process, government committed to in its hydrogen strategy, which was a strategic decision on blending 2023. The HyDeploy project team has been closely engaged with government, the HSE, OFGEM as well as wider stakeholders over the last year, supporting this process.

Through the Blending Strategic Decision[1], released on 14th December 2023, the Government determined that it saw strategic and economic value in blending up to 20% hydrogen by volume into the GB network. This is rightly subject to the review of the evidence developed regarding the safe use of hydrogen as a blend in the GB network, explicitly highlighting the work being undertaken by HyDeploy, as discussed further below.

2. www.assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf
3. Net Zero - The UK's contribution to stopping global warming, CCC May 2019
4. https://assets.publishing.service.gov.uk/media/65841578ed3c3400133bfcf7/hydrogen-strategy-update-to-market-december-2023.pdf
5. https://assets.publishing.service.gov.uk/media/63c0299ee90e0771c128965b/mission-zero-independent-review.pdf
6. https://www.theccc.org.uk/publication/delivering-a-reliable-decarbonised-power-system



The key strategic benefits for hydrogen blending identified include:

Unlocking early rapid build out of hydrogen production by providing offtake resilience. Developing a nascent market for hydrogen production is challenging. Blending provides an opportunity for investors in production to underpin offtake, particularly in the early stages of the market. This is strongly recognised as a benefit in the strategic decision.

In the absence of early large scale hydrogen transport and storage infrastructure, blending acts as a strategic enabler, particularly for electrolytic producers. The CCC has been clear about the role it sees for hydrogen in supporting the electricity network, and this early enabling step expedites this process, noting the 2035 target for a decarbonised electricity grid.

It is recognised that this is a transitional, but important role. Each MWh of natural gas that is displaced today avoids emissions of around 200kg of carbon dioxide at the point of use, with the New Low Carbon Hydrogen Standard ensuring that only low carbon hydrogen is supported and delivered. Ultimately it is important that the sectors of the energy system where hydrogen offers greatest strategic benefits are prioritised. Therefore, Government is keen that blending does not crowd these out, but it has recognised that blending plays an important role on that journey. This is reflected by the appetite of hydrogen producers to engage with blending as part of their development plans. It is also worth noting that in other countries, there is a view that blending hydrogen into the gas grid is simply the equivalent of putting renewable electricity into the electricity grid, so that buyers should be able to contract across the grid with appropriate certificates.

Next steps toward commercialisation

As part of the strategic policy decision, government announced that it would review the safety evidence, working closely with the HSE to ensure that it is assessed independently and robustly. This is aligned with the expectation of the HyDeploy team, noting this is a wider process than originally anticipated at the start of the HyDeploy programme which was focused on local exemptions rather than building and reviewing a national evidence base. This is helpful in accelerating the journey to implementation and provides a framework for review which combines both the Government and the HSE.

Subject to the outcome of the review, alongside finalising the economic assessment, then government would look to undertake a legislative process. Its view is that enabling blending at scale requires amendments to legislation, including the GS(M)R. It is important to note that if the evidence does not support a wider change to the regulations, then projects may still be able to apply for regulatory exemptions.

The primary mechanism to support blending is anticipated to be using the Hydrogen Production Business Model. This does require modifications to that model, but these were contemplated at the point of its development, and so the framework should be able to accommodate it.

The anticipated technical delivery model is to mimic the existing arrangements for connections to the gas network, allowing the market to decide where to inject the hydrogen, with the GDNs managing connections and network entry to monitor blend levels to ensure limits are not breached. In terms of billing, government intends to work within existing gas billing framework as laid out by the Future Billing Methodology Project. Significant amounts of hydrogen blending could be achieved under this approach, and this is viewed as the lowest cost and quickest to implement option for hydrogen blending.

The very substantial progress that has been made in the UK regarding delivery of the wider Hydrogen Economy, combined with the specific interventions and policy decisions in respect of blending, provides a sound basis for the outcomes of the HyDeploy project to be implemented commercially. The extensive technical work undertaken by HyDeploy has allowed government to focus on the strategic and economic case, knowing that the project will provide the safety evidence for it to review alongside the HSE, on a national basis.

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4.0 Progress against plan

The project exceeded expectations during the first trial in Winlaton which led to a change in the project direction and subsequently an updated project plan with progress against each programme elements is summarised below.

The focus of the year has been on expanding, producing, and reviewing the evidence related to the national gas distribution system. This has meant an extensive programme of work in key areas including materials and assets, industrial and commercial users and GDN procedures. Testing of global significance has been undertaken by the HyDeploy project on materials such as cast iron and other steels.

Progress against the plan has consistently met objectives and demonstrated a commitment to produce evidence of the highest quality. As the project now advances to its final stages, efforts are being made to refine and consolidate this progress into final reports, which will provide a robust representation of the project achievements and insights. These reports will be submitted to the HSE for technical review.

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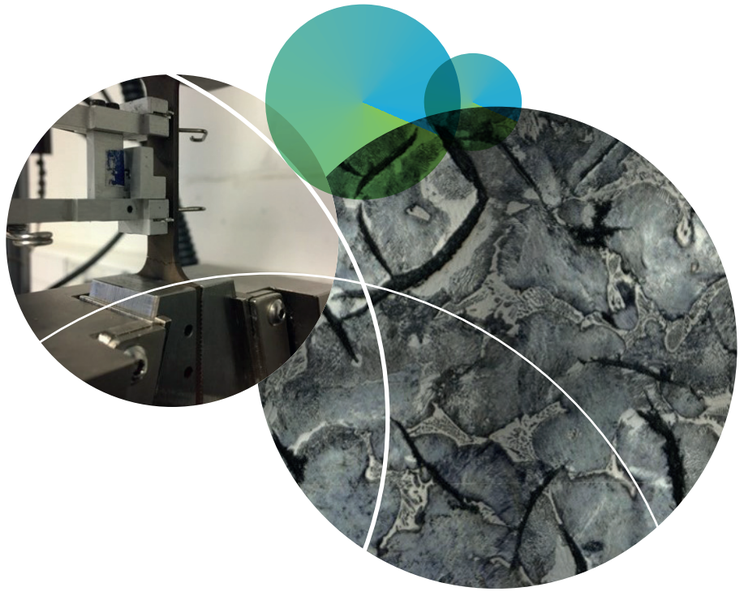
Programme element	Progress
1. Evidence for Wider Roll-out – Materials & Assets	The materials and assets workstream has made significant progress this past year. The key challenge of making a GB wide suitability assessment for repurposing natural gas assets to operate with hydrogen blended gas, is to determine a method that can make generic assessments without having to conduct a bespoke assessment on each of the individual tens of thousands of gas distribution assets installed on the GB network. The first step was to determine a GB gas distribution asset register by looking at existing asset registers from the networks (Cadent and NGN) as a reasonable representation of the types and classes of asset that is found on the distribution networks, reinforced by a review of the current and legacy standards which inform distribution operators of what assets can be installed and what their materials of construction can or can't be. This allowed the project to determine an exhaustive list of assets categorised by class and type so that a methodical assessment could be conducted. The second step was to develop a generic methodology which allowed all the identified network assets to be assessed through a 'screening process', which allowed for a significant number of differing assets to be generically screened through a robust process to identify the level of risk associated with that asset as it currently operates on natural gas and how the risk level changes by introducing hydrogen. This provided reassurance that finite project resources expended in this workstream focussed on areas of priority (high risk). The asset screening method was a product of collaboration with the H21 programme where the fundamental method was previously developed and used as part of the NIA 276 project to risk screen natural gas distribution assets for operation in pure hydrogen up to 7 bar (g) operating pressure. HyDeploy extended the methodology so that it became applicable for assets operating up to 70 bar (g) to incorporate assets on the HP tier of the distribution networks. The completion of this screening assessment was a significant task as it involved numerous stakeholders from the distribution network operations as well as a range of asset subject matter experts (SMEs) across the industry. Upon completion of this activity, the project was able to short list those higher risk assets for further investigation including materials testing of different cast irons, martensitic stainless steels, and X Grade carbon steels, which is currently on-going and nearing completion. The project collaborated with the Future Grid programme (National Gas) and the LTS Futures Programme (Scotia Gas Networks) which have been developing test data for operating HP assets on hydrogen, to inform assessments for operating HP assets in hydrogen blends. Non-metals have also been studied and investigated with considerable amounts of literature available to reinforce conclusions. The workstream will complete in Q1 of 2024.

Programme element	Progress
2. Evidence for Wider Roll-out – Domestic Appliances	The domestic appliance evidence base was successfully used to enable the Winlaton trial. In 2023, this evidence was developed further to ensure it was applicable across the nation. The existing base covered appliances introduced since 1976 and further work has been conducted to extend the evidence base to include pre-1976 town gas appliances modified for use with natural gas. Overall, the domestic appliance workstream has demonstrated that all existing natural gas domestic appliances present on the GB distribution network are compatible with hydrogen blends from both a performance and safety perspective.
3. Evidence for Wider Roll-out – Gas Characteristics	Following the successful development of the gas characteristics evidence base to support the Winlaton trial, the focus in 2023 shifted towards the identification and closing of final evidence gaps so that it could be applied to the entire network. Substantial work has been undertaken looking at how network operational procedures may need to be modified, and the long-term impacts of a blended gas. Within this area understanding the impact of blended gas on gas characteristics provides the foundation for analysing operational procedures. To support this work substantial research into purging, permeation and flow velocities has taken place. For example, an extensive programme of testing has been undertaken at DNV Spadeadam utilising a bespoke experimental facility to define safe purging operational parameters. To support the overall risk assessment for a blended gas network DNV has conducted a detailed study looking at the changes in risk associated with consequences from high pressure pipelines. This work has expanded the risk assessment evidence base to cover domestic and network pressures.



Programme element	Progress
4. Evidence for Wider Roll-out – Industrial & Commercial Gas Users	The I&C workstream has been a key focus of the 2023 HyDeploy work scope. Following the conclusion of the physical industrial trials with Lucideon and Campden BRI in 2022, the scope of work evolved into analysis of the potential hazards associated with a transition to hydrogen blend specific to I&C facilities. Ultimately, the I&C work focused on closing evidence gaps to unlock hydrogen blending across the gas distribution network. A wider engineering and regulatory compliance study was conducted, that considered and categorised compliance requirements to determine how they could be interpreted for a hydrogen blend and to identify common hazard assessment areas across the diverse range of I&C settings. The impact assessment framework was developed to consolidate the relevant findings across the I&C workstream into a hazards matrix that highlights generic safety related impacts that I&C sites could be expected to encounter upon transition to a hydrogen blend. A set of I&C case studies were commissioned in 2023 to test the framework for safety impact analysis of I&C facilities transitioning to a hydrogen blend. The purpose of the case studies is to evaluate the real-life impacts of a transition to a hydrogen blend and demonstrate the magnitude of any modifications that I&C facilities may have to make to their existing natural gas equipment and assets to ensure continued safe operation of their facilities. Case study host sites were selected to maximise coverage of different equipment types across different I&C sectors. The case studies tested the impact assessment framework, enabling refinement of the methodology so that it can be developed into a guidance document, that can be widely applied across the vast I&C sector upon the implementation of a hydrogen blend. Dedicated technical studies were also conducted to explore the impacts of a hydrogen blend on different types of natural gas industrial equipment to address evidence gaps that were not previously considered by the domestic HyDeploy programme. The focused technical studies covered reciprocating gas engines, gas turbines, gas compressors, and chemical feedstock processes.
5. Evidence for Wider Roll-out – Procedures	During 2023, the work to document and evaluate the impact of introducing a hydrogen blend into the GB gas distribution network has continued. The approach to capturing the responses to the technical questions was condensed into over 100 Q&A style proformas, encompassing the scope of the technical questions raised by ROSEN. Addressing these proformas has been the focus of the workstream during 2023 using references to existing literature, specialist evidence, test reports and expert engineering judgement by the SMEs. Once addressed, the proformas have gone through the technical Procedures Peer Review Group (PPRG) for peer review by SMEs before being passed to ROSEN for inclusion in the technical reports. The technical information in the completed proformas will provide the fundamental evidence to produce the ultimate outcome of this workstream in the form of numerous technical impact assessment reports. The technical reports will be designed to provide details surrounding the scope and impact of changes and have been split by generic technical subjects such as metering, mains laying, welding, pressure vessels etc. These reports will feed into the overall evidence submission in 2024 and will aim to provide a view on the level of effort required to update gas network procedures prior to wide scale roll-out.

Programme element	Progress
6. Extension of evidence base required for wider deployment	See sections 1-5.
7. Generic activities applicable to all sites	Following the accepted material change request, only one exemption-based network trial was undertaken as part of the HyDeploy2 programme. Therefore, please see section 9 and 10 of this table..
8. Local engagement and evidence gathering	HyDeploy has been facilitating and leading discussions on hydrogen blending since the programme first commenced in 2017. These communications provided government with confidence to make their strategic policy decision in December 2023. **Overview** Following the success of the Winlaton trial, HyDeploy has continued to engage with consumers to improve our understanding of customer perceptions and take lessons from the work. Residents' perceptions of the HyDeploy trial in Winlaton were gathered via 130 survey responses (19% residences) and 11 resident interviews prior to the trial starting, and 50 survey responses (7% residences) and 9 resident interviews towards the end of the trial. The lower response rate towards the end of the trial was deemed by the social scientists to belikely due to a decreasing interest in the trial due to the lack of disruptions and impact experienced. 78% of end-of-trial survey respondents were pleased to be part of the HyDeploy project. The before and after trial interviews and surveys included references to pride in being part of the trial, the need for projects like this to tackle greenhouse gas emissions, and the positive feelings of contributing to environmental action but without needing to do anything. One respondent commented: "It's an easy way to do your little bit, without noticing any difference, basically". **Concerns, reassurances, and trust** Where concerns about being part of the project were given, these concerns were primarily related to safety. The survey respondents towards the end of the trial who said that they had initial safety concerns about the project largely felt that these concerns had been mitigated over the course of the trial. Some respondents felt high levels of trust that the trial would be safe, and it would not be occurring if there were safety risks. **Positive, indirect consequences of the trial** There were positive indirect consequences of the HyDeploy communications, with some individuals saying that they had become more aware of the environmental impacts of home gas use, with some customers even saying that this had led to reduced energy use commenting: *"It's just made me more self-aware of the environment and of the impact it has for the long term".* At the end of the trial both the survey responses and interviews showed that customers experienced no obvious difference in their gas supplies with one respondent adding: *"I mean there's been absolutely no changes for us. Everything's been run smoothly. There's not been any issues or anything. So, it's been fine, yes."*

Programme element	Progress
8. Local engagement and evidence gathering	**Summary** The results of this research mirror the findings from the Keele University trial despite the very different demographic of the customers involved. As the only UK blending trial, this research has provided a unique insight into how the public might react to a wider roll-out of blended hydrogen in the home. The results suggest that the public can be broadly supportive of hydrogen in the home because of the perceived positive environmental implications, albeit not at the expense of the householder. Although some initial concerns around safety are likely, customers can be reassured, but this does require careful planning of communications and ensuring access for customers to have queries addressed.
9. Develop and submit site specific exemption.	A decision was made in 2021 to the change the project direction for HyDeploy 2 from development of a second trial to creation of a GB wide evidence base. There have been ongoing discussions between HyDeploy, DESNZ and the HSE to understand the process by which blending at scale can be implemented e.g., by an exemption process or a more fundamental change to regulations. This project will not be applying for another exemption, the process to allow blending at scale following any review of evidence provided by HyDeploy for the GB gas distribution system will be determined by the HSE and DESNZ following submission of the final evidence base.
10. Site preparation, installation, and commissioning	The Winlaton Trial site was successfully prepared, installed, and commissioned in August 2021.
11. Live trial	This was completed in 2022, with any evidence generated to be used in support of the national safety evidence submission to the HSE.
12. Site reinstatement and engagement close out	This was completed in 2022, with any evidence generated to be used in support of the national safety evidence submission to the HSE.
13. Network models for deployment	The evidence gathered on networks within HyDeploy spans the entirety of the GB gas distribution supply and therefore this is now considered the model for deployment. Following a comprehensive review of the HyDeploy evidence, the HSE will communicate their findings to DESNZ to inform the next decision stage. DESNZ, based on the safety review outputs and economic impact assessments, will decide on wide scale roll-out of hydrogen blends. Models for deployment extend beyond the evidence base and will involve engagement with hydrogen producers to evaluate connection requirements, geographical locations, and their associated timelines for integration into the gas distribution system. HyDeploy has maintained communication with relevant bodies to inform implementation planning.

Programme element	Progress
14. Regulatory and commercial basis for deployment	The strategic decision for blending made in December 2023, alluded to the need for a review of safety evidence prior to any change in regulation. It stated, *"Government intends to review this evidence before any steps to implement blending, such as amendments to the Gas Safety (Management) Regulations 1996 (GS(M)R), are made"*[1]. *The project aims to submit all safety evidence concerning the proposed change in gas for the existing gas distribution system. Any proposed change to the current limit of 0.1%Vol Hydrogen will need to be reviewed by the HSE.* *To ensure blending at scale can be rolled out efficiently and swiftly, the government has indicated in the same document that "blending should be implemented in a way that is of least cost and change to current gas system arrangements"*[1]. The HyDeploy project has been working closely with government and industry to provide input into the review of the commercial regulation, codes, agreements, and licences. The design of any formal changes will be done outside of the HyDeploy project.
15. Skills and training	This was completed in 2021 with any evidence generated to be used in support of the national safety evidence submission to the HSE.
16. Communications and dissemination	In 2021, the UK government published its first Hydrogen Strategy and 2023 was identified as when a key decision on hydrogen blending would be made. HyDeploy has been consistently engaging with key officials in DESNZ regarding the evidence and benefits of hydrogen blending. In December 2023, DESNZ delivered a strategic decision on blending, following a public consultation with industry. Hydrogen was at the forefront of discussions across the industry in 2023, due to the vast amount of innovation projects being developed across the full value chain. With discussions focussing on 100% hydrogen and its production, storage and use, blending was able to take a period of consolidation and consideration with regards to the ongoing communications. Nevertheless, HyDeploy continued to engage with stakeholders on its outputs and roadmap through a variety of communication methods. In September 2023, HyDeploy in collaboration with Xoserve, released a podcast which discussed the customer experience of using a hydrogen blend amongst other technical aspects of the project. The podcast episode can be found here: https://podcast.xoserve.com/2047715/13677894 HyDeploy has effectively communicated and disseminated its key outputs through strategic participation in a variety of conferences tailored to diverse audiences. Notable speaking engagement events include Utility Week Live, The Energy Innovation Summit, IMechE hydrogen conference and the supply chain school virtual conference, where the project described the work done to date to advance hydrogen blending. The project has also been proactively maintaining its online presence by regularly updating the official project website with important information on hydrogen blending. A project summary video was uploaded to the site to highlight the significant milestones achieved to date.

Programme element	Progress
16. Communications and dissemination	Following the Winlaton exemption HyDeploy, technical reports were uploaded to the Institute of Gas Engineers and Managers (IGEM) online hydrogen knowledge centre to facilitate open collaboration. Feedback from IGEM has shown that some of the most viewed content on the knowledge centre is the HyDeploy reports, not just here in the UK but also across the world. For example, the outputs and learning from the successful domestic demonstrations have also been shared internationally with a presentation delivered to FortisBC, which is British Columbia's gas distribution network and ITALGAS (Italian distribution network) as they prepare to conduct their own blending trials. Going into 2024, the top priority of HyDeploy is the completion and submission of the projects technical evidence base which can subsequently be disseminated with relevant stakeholders. HyDeploy will once again make all evidence reports available to the public which can then be used to benefit industry projects in the UK and across the globe.
17. Project management	Effective project management is necessary to deliver a project with six partners and multiple work streams. The governance structure is provided by the steering group which meets quarterly. A well-managed system of monthly project meetings with associated programme and budget reporting is in place, and a comprehensive project risk register being used to manage the programme. Subsidiary working groups monitor and progress individual work streams.

5.0 Progress against budget

The table below shows the progress against budget to the end of December 2023. The programme is being managed for overall delivery within budget.

Progress against budget has been delivered within requirements this year. The majority of spend has been dedicated to extending the evidence to cover wider deployment of hydrogen blends (Programme element 6) with also a key focus on evidence required to test and review materials for their use with hydrogen blends.

Due to the change in project direction, individual programme elements have differed when compared against original budget however this has not impacted overall budget management. HyDeploy has worked collaboratively with other projects producing evidence for 100% hydrogen to ensure efficiencies are explored, especially in terms of value for money and cost reduction. This approach has ensured that the project can still be operated within budget whilst also producing the highest quality outputs.

Programme element	Spend to date (£)	Budget to date (£)	Total budget (£)
1. Exemption evidence - Materials	1,008.775	877.947	934,031
2. Exemption evidence – Appliances	882.324	468.064	497,965
3. Exemption evidence – Gas Characteristics	1,972.073	1,397.552	1,486,829
4. Exemption evidence – Gas Detection	56.784	209.885	223,292
5. Exemption evidence – Procedures	472.721	281.206	299,170
6. Extension of evidence base required for wider deployment	2,425.483	2,059.933	2,191,524
7. Generic activities applicable to all sites	1,056.032	955.505	1,016,544
8. Local engagement and evidence gathering	274.958	1,343.113	1,428,912
9. Develop and submit site specific exemption	731.287	711.613	757,072
10. Site preparation, installation and commissioning	2,102.648	2,142.363	2,279,219
11. Live trial	202.072	1,665.035	1,771,399
12. Site reinstatement and engagement close out	30.995	158.291	168,403
13. Network models for deployment	4.070	32.450	34,523
14. Regulatory and commercial basis for deployment	28.128	131.720	205,244
15. Skills and training	7.863	64.800	68,940
16. Communications and dissemination	103.613	354.529	312,068
17. Project management	1,709.424	1,215.931	1,293,606
Total	**13,069.250**	**14,069.937**	**14,968,741**

6.0 Project bank account

Bank statements have been provided to Ofgem. Due to the confidential nature of the project bank statements, they have not been included in this report.

7.0 Successful delivery reward criteria

All scheduled Successful Delivery Reward Criteria were completed in full during this period, as tabulated below and as evidenced to OFGEM.

SDRC1: Communications plan
25th October 2019

SDRC2: Evidence Base for First Trial
30th June 2020

SDRC3: Exemption Submission
22nd September 2020

SDRC4: Winlaton Trial Commencement
4th August 2021

SDRC5: Evidence Base for Roll-Out
31st March 2022

SDRC6: First Trial Completion and Interim Roadmap
31st January 2023

8.0 Data access details

No public network or consumption data has been collected on this project to date.

9.0 Learning outcomes

The following key learning points have been identified by the project during this period and provided the foundation for delivery of the ongoing programme, as well as informing national roll-out.

People. The HyDeploy programme completed its 6th successive year of successful project delivery through 2022. This achievement was possible due to the continued efforts of a team of highly dedicated and capable individuals and organisations, both project partners and subcontractors. Successful delivery of innovative projects like HyDeploy is contingent upon the right people, with the right experience, knowledge, and focus.

Collaboration. Cross programme collaboration has been a particular achievement driven by HyDeploy. The increase in hydrogen research programmes generated the risk of duplication and misalignment. HyDeploy was keen to ensure that resources were spent efficiently, particularly in materials testing as it can be a resource heavy field. A cross industry materials working group was established via the ENA, wherein all GDNs developed evidence regarding the suitability of materials and assets to be repurposed for hydrogen, and all GDNs were informed of one another's programmes, schedules, results, and conclusions – this has been a key learning outcome.

Adaptability. Given the enormous success of the Winlaton public demonstration, meaning that the evidence for that trial took the research so much further than anticipated, negated the need for a second public demonstration and rather, a redirection to develop an evidence base for the roll-out of hydrogen across the GB distribution networks. This change in direction required the entire HyDeploy consortium and the subsidiary contractors and stakeholders to understand what this step change meant with respect to how the remainder of the evidence needed to be investigated and presented, given the reduced availability of the HSE.

Stakeholder engagement. The importance of stakeholder engagement was personified over the past 12 months as HyDeploy embarked on a tripartite engagement journey with DESNZ and the HSE. Both stakeholders were custodians of the same output from HyDeploy such as the safety evidence, but from different perspectives. The HSE are making the direct safety assessment of the presented evidence, whilst DESNZ are also interested in developing the business case for blending and determining the value for money, if investment was required to introduce blended networks. The HyDeploy team took great care to harbour relationships, and it was evident to learn the value of clear concise communications, as well as information sharing.

Hydrogen Supply. An increase in hydrogen related research in the UK led to a small period of scarcity of supply. However, the project maintained resilient hydrogen supplies through carefully negotiated contracts, designed to provide reliable hydrogen availability during the trials.

Stakeholder Engagement. An increase in hydrogen related safety studies has increased the draw on key stakeholder resources within the gas industry, particularly safety studies requiring the attention of the HSE. The project continues its tripartite engagement with the HSE and BEIS in aide of the prospected BEIS policy decision on hydrogen blended networks and remains flexible in providing the necessary support and information as requested.

10.0 Intellectual Property Rights

No registerable IPR has arisen during the period.

11.0 Risk management

Effective risk management is critical for successful project delivery. A risk register is being used as a project management tool.

Going into 2023 the key project delivery risks were associated with supporting the government in its strategic policy decision and progressing the GB wide evidence base for hydrogen blending.

Contractor delivery. With the rise in hydrogen research programmes and a small pool of SMEs in the field, the draw on contractors has stretched timelines and deadlines. This has been managed by individual project managers representing each HyDeploy consortium partner to hold contractors to account and plan such that delays are kept to a minimum.

Resource turnover. 2023 has seen considerable movement of individuals both leaving the project and joining the project. This has been managed by ensuring a core set of project partners from each consortium has been retained throughout the whole programme, allowing for efficient handovers and continuity of progress.

12.0 Accuracy assurance statement

This report has been prepared in accordance with the Gas Network Innovation Competition Governance Document published by Ofgem. The project has been subject to review and challenge by the Cadent Project Manager and signed off by Damien Hawke, Cadent, Future Networks, who is Project Sponsor for this NIC project.

Damien Hawke has confirmed that the processes in place and steps taken to prepare this Project Progress Report are sufficiently robust, and that the information provided is accurate and complete.

The project team

HyDeploy2 is being delivered by the HyDeploy consortium, which has technical expertise and practical experience. The partners are:

Cadent Gas (formerly National Grid Gas Distribution) is leading HyDeploy2. They own and operate four of the eight gas distribution networks in the UK, including the West Midlands.

Northern Gas Networks is partnered with Cadent to deliver HyDeploy2. They own and operate the gas network in the North East, Northern Cumbria and much of Yorkshire.

Keele University is providing learning from the first HyDeploy trial and providing continuity of consortia through the HyDeploy2 trials.

HSE Bespoke Research and Consultancy is the consulting arm of the Health & Safety Executive. They will be providing the scientific evidence which will support the safety case for the public trials.

ITM Power manufacture integrated hydrogen energy solutions.

Progressive Energy is an independent UK clean energy company. It will be supporting the management of HyDeploy2 through development and implementation.

In addition to the core project partners the project is supported by a number of key companies:

Kiwa specialise in gas testing. It is carrying out offsite testing on a range of common household appliances to inform the project and will lead the gas safety appliance checks on the campus.

Dave Lander is an internationally recognised expert in gas quality and safety and co-ordinated the Exemption application to the HSE.

HyDeploy

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