Electricity/Gas Network Innovation Competition Screening Submission Pro forma

Notes on completion		
Before completing this form, please refer to the relevant Network Innovation Competition (NIC) Governance Document(s). Please use the default font (Verdana size 10) in your submission. We will only accept the text visible in the text entry areas. The text entry areas are predetermined and should **not** be changed. The full-completed submission should not exceed 10 pages in total. Ofgem will publish all the information contained within this Screening Submission.		
Is the application for the Gas or Electricity NIC?	Gas NIC ☒	Electricity NIC ☐
Cross Industry Project	YES ☐ *If yes, please fill out Cross Industry Projects section*	NO ☒

Funding Licensee(s)
Cadent Gas Limited Northern Gas Networks Limited
Network Licensee Project Partners
Health and Safety Laboratory, Progressive Energy, ITM Power
Funding Licensee area(s)
North West North East
Project Title
HyDeploy II
Project Summary
The Licensee(s) must provide an approximate Project start and end date.
The Problem: The UK has committed to substantial carbon savings; heat contributes to a third of its current emissions. Reducing heating carbon intensity via hydrogen over the gas grid provides a customer-focused solution, but is limited by the current tight GS(M)R UK limits. **The Method:** Building on the foundational work undertaken at Keele, this will be the first GB deployment of hydrogen into the *public* gas network. It will move from the requirement to survey, test and trial all parts of a network prior to injection, to the ability to inject into an untested network, as necessary for roll out. This will be achieved through development of a representative and resilient evidence base though further trials & a roadmap for hydrogen deployment through blending in a 44 month project, running from Apr-19 to Nov-22 **The Solution:** The project objective is that a supplier of hydrogen is able to apply to inject hydrogen into a GDNs network, just as biomethane producers can today. This enables hydrogen to deliver cost-effective and non-disruptive carbon savings to the customer. **The Benefits:** Successful demonstration has the potential to facilitate 29TWh pa of decarbonised heat in the GB, substantially more than the existing RHI scheme is projected to deliver, with the potential to unlock wider savings through more extensive use of hydrogen. It addresses the energy trilemma, saving £8billion to consumers, and avoiding 120 million tonnes of carbon by 2050, whilst providing a greater level of diversity in supply.

Estimated Project funding			
The Licensee must provide an approximate figure of the total cost of the project and the NIC funding it is applying for.			
Total Cost of Project	£14.6M	**NIC funding requested**	£13.2
Is the TRL of the Project at start date between 4 and 8?	YES ☒	NO ☐	

What is the Problem?

The Licensee must provide a narrative that explains the Problem(s) that the Project is seeking to address.

The UK is committed to a pathway to carbon reductions through the 2008 Climate Change Act. On the 30th June 2016 the Government adopted its ambitious and legally binding fifth carbon budget. Heat contributes a third of the UK's carbon emissions. The updated Carbon Plan (DECC, 2013) and more recently the Clean Growth Strategy (BEIS, 2017) specifically identifies the need for low carbon heat in order to meet these targets, with the Committee on Climate Change highlighting the limited progress in addressing this sector to date and the challenges ahead (CCC, 2018).

The Carbon Plan states that by 2030 there will be a requirement for between 83-165TWh of low carbon heat per annum. In 2015 the combined domestic and non-domestic Renewable Heat Incentive (RHI) delivered less than 4.5TWh, with an expectation by BEIS that by 2020/21 the entire RHI could deliver 23.7TWh of renewable heat (DECC, 2016). Therefore, a step change in low carbon heat is required.

Great Britain has a world class gas grid and gas dominates its heat supply curve, heating 83% of its buildings and providing most of its industrial heat. Heat demand is highly variable (Sansom, 2015) and compared with alternatives such as heat pumps, gas is readily capable of meeting peak heat. Delivering low carbon heat via gas capitalises on existing network assets cost effectively and means that customers do not require disruptive and expensive changes in their homes, which is recognised to be a substantial barrier to progress (WWU,2015).

Gas can be decarbonised by using bio- rather than fossil- carbon, biomethane, which is already increasingly & successfully deployed in the UK, or by using hydrogen. Two hydrogen scenarios are envisaged; either as a blend in the network feeding existing appliances with no requirement for changes to equipment or infrastructure, or as a conversion to 100% hydrogen. The former has the potential for roll out in the near future. It offers not only valuable decarbonisation and financial savings across the distribution system with no disruption to consumers, but it also provides a pathway to establishing hydrogen more widely. The UK currently only permits 0.1%v hydrogen in the network, despite formerly distributing town gas with ~50%v hydrogen. The HyDeploy project at Keele is establishing the first proof of principle that up to 20% hydrogen can be injected, and the requirement for subsequent public trials to achieve national deployment was made clear at the start of that project. There is a need to move from the requirement to survey, test & trial all parts of a network prior to injection, to injecting into an untested network, as necessary for roll out. That is what this project sets out to achieve.

What Method(s) will be used?

The Licensee must describe the Method(s) that are being demonstrated or developed. It must also outline how the Method(s) could solve the Problem. The type of Method should be identified where possible eg technical, commercial etc.

The Method proposed is to reduce the carbon intensity of heat, cost effectively, via hydrogen blending in the gas grid. Based on the foundational HyDeploy trial at Keele, the objective is to enable deployment and rollout across the UK. The outturn project objective is that a supplier of hydrogen will be able to apply to inject hydrogen into a GDNs network, just as biomethane producers can today, enabling delivery of cost-effective & non-disruptive carbon savings to the customer. It is important to commence in 2019 for a seamless transition of equipment & teams from Keele to the first public trial, maintaining momentum & delivering timely deployment.
The Method proposed builds on the principles established in the HyDeploy project at Keele, whilst drawing on best practice from the work by SGN in the "Opening up the gas network" project, as well as other work internationally. The purpose of the Keele project was to provide the core evidence base require to support in principle the injection of hydrogen in the UK. For a first project, a closed private network was deliberately chosen to enable the most complete dataset to be collected about the network, with as many variables controlled. This not only enabled sound risk management in this first project, but also provided a greater level of reassurance for those involved. The proposed project will address the key elements necessary to translate from the seminal project at Keele to full deployment. It will move from the requirement to survey, test and trial all parts of a network prior to injection, to the ability to inject into an untested network, as necessary for roll out. It will also provide a comprehensive roadmap for deployment. The Method being undertaken in this 44 month project, running from Apr-19 to Nov-22 has three main components as described below.
Evidence Base: Required to support both the specific public trials & address wider network

Method(s) continued

requirements during roll out. **Public trial specific evidence.** This builds on the principles established at Keele, extended to cover the specifics of the public trials; the wider range of appliances, extended materials usage and impact on life assessment, gas detection and odourisation, specific network attributes such as inserted mains and other sources of gas tracking, and operational procedures on the wider network. **Wider deployment evidence.** Deployment requires that all consumers can accept the blend. Whilst commercial installations have been extensively covered at Keele, with more expected alongside the public trials, the evidence base for industrial users must be developed. Based on work by Cadent in its HyNet project, blend tests will be undertaken on industrial boilers as well as high temperature furnaces & kilns in the ceramic & glass sectors. Other work relating to CHP & CNG transport applications will also be reviewed. Output from the roadmap work will be used to ensure that evidence is developed for appropriate pressure tiers & network control strategies for the future.
Trials: Two trials will be undertaken; one in Cadent's North West region and the other in the North East by NGN. Both trial locations will be selected based on the requirement to provide a statistically representative GB evidence base each one with around 750 domestic properties, matched to the scale of the existing equipment. **Engagement.** A comprehensive strategy will be developed, based on the practical experience at Keele. **Network and appliance survey**. During the **first trial** the project will seek to engage with every customer on the relevant network in order to undertake safety checks on every appliances and installation. Where required local testing on NG-H2 blends will be undertaken. The network will be surveyed, modelled & modified operational procedures established. **Secure GS(M)R Exemption.** Based on the technical evidence base, site specific data and a QRA, an Exemption application will be made to the HSE for blending. **Installation.** Subject to the granting of an application, the hydrogen production, injection and monitoring equipment developed at Keele will be relocated, installed and commissioned on site. **Injection trials**. A 12 month programme will be undertaken to confirm, understand and document the operational behaviour of the network and appliances. Whilst the Installation and Injection phases take place on the first site, customers on the **second trial** site will be engaged, a reduced network and appliance survey undertaken, and the next Exemption developed based on this simplified data set as part of a trajectory towards roll out. Equipment will then be relocated and injection trials undertaken.
Roadmap: A full deployment plan for hydrogen blending on the network will be developed. This activity will be undertaken concurrently with the two other project elements, as it will feed into these as well as draw on their outcomes. This work package comprises four components. **Network models.** System techno-economic assessment, including cost optimal network injection points and pressure tiers, linked to network capacity, scale of hydrogen sources and types, and existing/expected network control strategies. **Regulatory basis**. Practical deployment of metering and billing, based on the outputs from the FBM NIC focused on blending including engagement with shippers and suppliers. Transition from case by case exemption to regulation changes. **Commercial basis.** Refinement of ownership models and provision of techno-economic data to enable development by HMG of appropriate support structures. **Skills and Training.** Establish the optimal approach for developing the skills required not only within the GDNs, but also amongst the wider gas fitter community. Together these four components will form a **Comprehensive Roadmap** for full deployment.
Key rationale for the proposal, in relation to the current project at Keele:
It is necessary: Public trialling is a necessary step from the trial at Keele to full deployment. This was an integral part of the first NIC project proposal & previously supported by Ofgem through the expert panel with full visibility of the requirement. **It requires more than one trial:** At full deployment, applicants to inject hydrogen cannot be required to undertake safety checks in every home affected. Therefore it is critical that sufficient, statistically representative evidence is collected in this project. Given the relative geographical homogeneity of housing stock, this is difficult to achieve in a single location, delivering a sufficient range of appliances and network materials and components. The second trial must also support the principle of reduced data collection at the Exemption stage, based on the evidence from the first trial, to enable subsequent roll out. **It is timely:** The first phase of HyDeploy at Keele is reaching the final stage, with the completion of the Exemption application imminent. No fundamental barriers to blending have been identified. The live trial at Keele will be completed in March 2020; equipment should be directly transferred to the public trial (a) to avoid mothballing and (b) to expedite roll out of blending as rapidly as possible. It is critical to maintain momentum.

Funding Commentary
The Licensee must provide a commentary on the accuracy of its funding estimate. If the Project has phases, the Licensee must identify the approximate cost of each phase. OFTOs should indicate potential bid costs expenses
The Project Cost estimate has been developed, based on the detailed knowledge and understanding developed by the project partners building on the experience from the project at Keele. 1. EVIDENCE BASE DEVELOPMENT (£6.58m) a) **Extension of evidence for public trials.** Includes extended materials types and appliance base, gas detection, specific network attributes, operational procedures development & non-compliant installation testing based on trial 1 safety checks b) **Extension of evidence for roll out.** Includes development of evidence base for appropriate pressure tiers and network control strategies as well as necessary work, including onsite testing to establish that there are no barriers to roll out imposed by industrial users on the distribution network, based on HyNet assessment of requirements 2) PUBLIC NETWORK TRIALS (£6.48m) a) **Generic Activities applicable to both Sites.** Includes development of stakeholder engagement plan, engagement with suppliers, shippers, manufacturers, billing strategy, governance and liability review b) **First Site Specific Programme.** Includes delivery of local engagement plan, arrangement and delivery of safety checks (750 installations), bottle testing of subset, legally required remedial works, develop Exemption inc QRA, secure, prepare hydrogen injection site, installation & commissioning, live trial phase including services and billing obligations, data acquisition, post-trial assessments & decommissioning c) **Second Site Specific Programme.** As for first site, but with reduced safety checks scope and no bottle testing 3) ROADMAP FOR FULL DEPLOYMENT (£0.46m) a) **Network models for deployment.** Includes wider network capacity assessment, linked to potential hydrogen sources at roll out, techno-economic assessment of scale vs pressure tier, evaluation against future network control strategies b) **Regulatory basis for deployment.** Includes national billing strategy, based on FBM, fiscal metering requirements, future Exemptions including changes from GSMR to Standard c) **Commercial basis for deployment.** Ownership models for equipment and techno economic model to support development by HMG of appropriate support structures d) **Training and Skills.** Includes development of strategy and training material for Gas Fitters and service engineers in order to support roll out 4) DISSEMINATION AND PM (£1.08m) a) **Dissemination and wider communications.** Includes communication with wider general public ahead of full deployment, policymakers, all elements of the gas and hydrogen supply chain, as well as formal dissemination of project results and outcomes. b) **Project Management.** Project management required across the consortium and by the parties to deliver the project, including governance processes through the project steering committee and advisory board Costs at this stage are +/-20%, and will be refined at the full bid stage. This is a 44 month programme, commencing in April 2019 and due for completion November 2022.

Which Specific Requirements do the Project fulfil?(Please tick which of the Specific Requirements this Project fulfils)		
	Electricity	**Gas**
A specific piece of new (ie unproven in GB) equipment (including control and/or communications systems and/or software)	☐	☒
A specific novel arrangement or application of existing electricity/gas transmission and/or distribution equipment (including control and communications systems software)	☐	☒
A specific novel operational practice directly related to the operation of the electricity/gas transmission and/or distribution systems	☐	☒
A specific novel commercial arrangement	☐	☒

How does the Project accelerate the development of a low carbon energy sector & have the potential to deliver net financial benefits to existing and/or future customers?

The Licensee must demonstrate that the Solution has the potential to accelerate the development of the low carbon energy sector in GB and/or deliver wider environmental benefits to GB customers. The Licensee must demonstrate the potential to deliver net financial benefits to existing and/or future customers.

The Carbon Plan identifies the need to *'deliver between 83-165TWh of low carbon heat'* by 2030, but the RHI (Dom & Non-Dom) delivered less than 4.5TWh in 2015 and BEIS anticipates 'that by 2020/21, the RHI could deliver 23.7TWh of renewable heat'. A step change is required to meet low carbon heat commitments, (DECC,2016)

The Executive Summary in the Carbon Plan states that *'the oil and gas used to drive cars, heat buildings and power industry will, in large part, need to be replaced by electricity, sustainable bioenergy, or hydrogen'.* It identifies the consumer and network challenges associated with adoption of non-gas low carbon solutions such as biomass combustion or heat pumps (i.e. high capital costs, long installation timeframes, heating replacements being typical 'distress purchases' where the requirement is rapid reinstatement and added strain on the electricity grid). On a daily basis, peak heat demand is 5x the lowest demand, and on an hourly basis the peak is almost 10x the minimum. The gas grid is designed to accommodate these fluctuations in heat demand, whereas significant reinforcement of generation, transmission and distribution would be required to accommodate this via electricity alone.

BEIS identifies that 'Two low carbon fuels could be deployed through a national grid network, similar to how natural gas is delivered today: biomethane and hydrogen'. (DECC, 2012). It recognises that '*In the near term, relatively small quantities of hydrogen could also be injected into the gas grid to enrich natural gas and reduce carbon emissions from conventional gas-fired boilers'* and that *'it may also be possible to repurpose the existing low-pressure gas distribution grid to transport hydrogen at low pressures, which could be used in modified gas boilers and hobs, and in building-level fuel cells.'* It suggests that *'More evidence is needed on whether hydrogen-based approaches hold practical promise for the UK'*, which is repeated in the update (DECC, 2013) which emphasises the *'need to focus particular effort will be on heat storage and on hydrogen'.* Most recently BEIS' Clean Growth Strategy, (BEIS,2017) states that *'Clean fuels such as hydrogen and bioenergy could be used for transport, industry, and to heat our homes and businesses. We need to test how they work in the existing gas network, whether they can fire industrial processes, and how they could be used in domestic appliances.'*

The GB gas distribution network alone delivers over 400TWh. Establishing practical injection of hydrogen at a 20%vol fraction into this would deliver 29TWh of decarbonised fuel, more than that forecast for the entire RHI scheme in 2021. Analysis by National Grid in support of the HyDeploy project suggests that this equates to a cumulative CO2e saving of around 120 million tonnes by 2050 or around 6 million tonnes per annum. This is the equivalent of removing 2.5 million vehicles from the roads. Further, it would unlock progress on a more substantial hydrogen roadmap, which could see complete decarbonisation of some or all of the gas grid.

This solution enables gas customers to play their part in decarbonisation without disruptive and expensive demand-side changes. Gas customers receive their heat at present via the gas grid using gas boilers. Hydrogen blending allows customers to reduce the carbon intensity of the heat using their existing appliances. If this is not possible, then an equivalent quantity of low carbon heat must be delivered via another means, with the 'marginal' low carbon heat solution generally considered to be heat pumps. Based on analysis undertaken for the HyDeploy project, the cost savings to the consumer of low carbon heat delivered by hydrogen blending compared to an equivalent quantity of heat delivered by heat pumps is around £8 billion by 2050. This is on an NPV basis over the period, and includes capital and operational costs and the savings associated with avoided electricity network reinforcement otherwise required. However it does not include the additional peak electricity capacity requirement estimated to be around 10GWe to service 3 million avoided heat pumps, nor decommissioning of the gas grid. KMPG has compared an all gas low carbon future, with an all-electric one, seeking to account for all of the factors. Their assessment suggests that a gas-based solution costs the consumer £170 to £196 billion less compared with an electric approach, (KPMG,2016).

How will the Project deliver value for money for electricity/gas customers?

The Licensee must demonstrate that the Method(s) being used can derive benefits and resulting learning that can be attributed to or are applicable to the electricity/gas transmission and/or distribution systems.

The wider customer benefits of unlocking hydrogen as a decarbonisation vector are outlined above. It provides a cost saving of at least £8 billion cumulative by 2050 compared with the marginal low carbon alternative solution of heat pumps. More widely, based on KPMG's assessment, enabling adoption of hydrogen as part of a low carbon gas-based energy system could increase the savings by a multiple of more than twenty times.

This bid delivers value for money by reusing the equipment developed for the initial HyDeploy trial at Keele (Electrolyser, Hydrogen grid entry unit and analytical equipment) on two separate trial sites. This equates to over £1.5 million of design, development and fabrication. Seamless moving of this equipment to the new sites maximises utilisation. Even with the new programme commencing in April 2019, there will be a delay in relocation of this equipment to the first public site due to the necessary technical and customer engagement programme. Overall this project is expected to trial a hydrogen blend in over 1500 homes, in two distinct locations, providing the necessary data to support roll out covering a wide range of network configurations and appliance types. This equates to fifteen times more installations than at Keele, for less than double the cost, including clearing wider barriers to deployment.

This programme builds on an established core consortium, with established working practices and efficiencies. The project will be managed such that costs are controlled and value delivered. Cadent and NGN have executed many IFI/NIA/NIC projects and have well established contractual and governance arrangements for delivery, with an experienced management team structured to deliver the project cost-effectively. Based on the significant potential savings highlighted above, combined with the reuse of existing investments, the request for £13.2m from NIC to enable UK deployment offers good value. The programme will enable the GDNs to understand and develop the capabilities of their network as a practical & safe means to deliver low carbon, flexible heat. The specific learning from the project is therefore directly attributable to the gas transportation system.

How will the Project generate knowledge that can be shared amongst all relevant Network Licensees?

The Licensee must explain the learning that it expects the Method(s) to deliver, and how it will be shared. The Licensee must demonstrate that it has a robust methodology in place to capture the learning and how the learning is disseminated.

Knowledge generated. The purpose of the project is to provide the evidence base for all GDNs and regulators to accept blended hydrogen on the public gas network. The development of two Exemption applications will enable the transition from the first well bounded case at Keele to public network application. Key new knowledge from the two public trials will include (a) increase in customer base with larger demographic of appliances, property types and ages, (b) the necessary wide range of gas network materials, configurations such as inserted mains, local geology, and operational procedures and techniques arising from this. Given housing stock and network homogeneity, this cannot be achieved in one location and so necessitates two trials. Together the evidence from these trials will provide statistically representative GB data, particularly important to enable roll out in 2023. The public network operational procedures for hydrogen can be incorporated into GDN's existing safety cases. The technical learning comprises appliance operation, gas mixing into and throughout the network, impact of hydrogen on materials found in pipeline (including at LTS pressures), network equipment, meters and appliances, as well as leak detection & network maintenance procedures. Additionally, this project will provide detailed understanding of customer perceptions of hydrogen to inform the GDNs and supply chain engagement for full roll out.

Knowledge dissemination is integral to the project execution. The programme is collaborative between two GDNs; the other GDNs have engaged with the existing project and this is expected to continue. The Keele project model includes an Advisory Board, a very well received platform for engagement through the industry. Engagement with the supply chain through the Energy Utilities Alliance including the Heating and Hot Water Industries Council has been established as an effective means of engagement with the equipment supply chain, as well as IGEM and the Energy Network Association. Project partners are members of international programmes such as GERG, & will share at conferences such as LCNI.

Does the Project conform to the default IPR arrangements set out in the NIC Governance Document?	YES ☒	NO ☐

By selecting NO, the Licensee wishes to deviate from the default requirements for IPR. If this is the case, it must demonstrate how the learning will be disseminated to other relevant Licensees and how value for money will be ensured. The Licensee must also outline the proposed alternative arrangements and justify why the arrangements are more suitable than the default arrangements.

The purpose of this project is to provide the basis for all Network Licensees to enable hydrogen injection, as well as wider stakeholders to prepare for hydrogen blending. Therefore, the Network Licensees confirm that they will conform to the default IPR arrangements.

How does the project demonstrate it is innovative (ie not business as usual) and has an unproven business case, that the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness?

Demonstrate why the Licensee has not previously used this Method (including where the Solution involves commercial arrangements) and why NIC funding is required to undertake it. This must include why the Licensee would not run the Project as part of its business as usual and why the Solution is not Research.

Until 1967, the main UK energy carrier was town gas (a blend of H2 and CO). With the discovery of North Sea Gas, the grid was progressively converted over 10 years. Extensive technical work by Dutton established the impact on networks and appliances of a range of gas compositions through 'interchangeability' diagrams, but due to the lack of naturally occurring hydrogen in North Sea Gas, these were simplified to exclude its effects, setting the regulatory limit to just 0.1%. This has left the UK substantially behind countries such as Germany & Holland which have exploited much higher blends.

The barriers this project will address relate to the ability of UK GDNs to secure an appropriate hydrogen exemption from HSE on the public network, and to undertake operational trials of Hydrogen-Natural Gas blends. This builds on the foundational work at Keele and delivers the roadmap to wider roll out.

There is no financial benefit to the network, to undertake such a programme, and no reason it should do that under business as usual operation. The risks this programme seeks to address are:
Technical & Operational - operation of appliances safely on a blend, safe operation of the network including network flows, pipeline integrity, network maintenance and leak detection;
Commercial - metering of hydrogen and appropriate billing regimes; and
Regulatory – securing Exemptions to the GS(M)R and establishing the basis for future roll out.

None of these risks would need to be addressed if the GDNs were to continue to operate the network using natural gas. The rationale for the project is to enable an alternative, low cost & non-disruptive decarbonisation solution for the customer and for the UK to meet its carbon commitments.

How were project Partners, external resourcing/funding identified, and what are their roles?

The Licensee must provide evidence of how Project Partners were identified and selected, including details of the process that has been followed, and the rationale for selecting partners and ideas for the Project.

The Licensee should provide details of any Project Partners who will be actively involved in the Project and are prepared to devote time, resources and/or funding to the Project. If the Licensee has not identified any specific Project Partners, it should provide details of the type of Project Partners it wishes to attract to the Project.

Cadent is the Funding Licensee & project sponsor. Its innovation team undertakes an internal process to identify both new project ideas and participants. Through this process it identified the need to clear barriers to facilitate hydrogen adoption.
Northern Gas Networks is a collaborating GDN who have been leading flagship hydrogen innovation programmes, including H21 Leeds project.
Health and Safety Laboratory (HSL): One of the UK's foremost health and safety experimental research establishments. They have particular understanding of the issues that HSE need to see addressed in this field, and will plan & oversee the technical programme including analysis and synthesis of the results to provide the evidence base for Exemption.
ITM Power: provider of electrolysis unit and sourcing of grid injection facilities. They are uniquely experienced in hydrogen grid injection based on their work in Germany, where their equipment is current injecting hydrogen into the network.
Progressive Energy: Project management, planning and overall programme co-ordination. Selected based on proven NIC project management.
In addition to the core partners, the project is supported by key industry experts:
KIWA Gastec will undertake practical survey, test and trial work, building on their experience.
Dave Lander Consulting is a well-respected specialist in the field, and will develop the safety case and manage the submission to the HSE to secure the exemption.
Otto Simon (OSL) provides engineering services for projects, particularly more innovative systems in the process engineering sector and has a track record of delivery in NIC projects.
The core team was established for the HyDeploy project at Keele. It has worked extremely effectively together and seeks to bring their knowledge and experience to this next phase towards deployment. Where possible the team is keen to involve other experts in the field to improve collaborative work across the sector and enhance the UK delivery potential.

Will the Project require any derogations or exemptions?

The Licensee should outline if it considers that the Project will require any derogations, exemptions, or changes to the regulatory arrangements.

In order for these trials to proceed an Exemption from the requirements of Schedule 3 of the GS(M)R will be required, specifically a derogation to the hydrogen limit of 0.1%. Exemption from any requirement imposed by the GS(M)R are provided for by Regulation 11 of the GS(M)R. Essentially the HSE shall not grant an exemption *'unless it is satisfied that the health and safety of persons likely to be affected by the exemption will not be prejudiced in consequence of it'.* Exemptions may be granted subject to conditions and a limit in time and may be revoked at any time by a certificate in writing. The HSE decision for the Exemption for each trial, will be based on informed by the baseline survey work, extensive test data, wider scientific evidence base and the corresponding Quantitative Risk Assessment.

It is recognised that there are wider activities being undertaken across the gas industry, which may result in the requirements of Schedule 3 of the GS(M)R being embodied in a set of Standards, which may, in time change the current Exemption process. Fundamentally, the burden of evidence would still be required in this regime in order to provide the basis for the proposed hydrogen level in such a standard. Members of this project consortium are also active participants in this IGEM led process. As at Keele, there will also be a requirement for derogation for supply of gas by a GDN from the Cadent owned electrolyser for trial purposes.

Billing arrangements will require approval. It is anticipated that a declared CV billing regime will be used for the trial area, validated by CV data collected from the grid entry unit. However, unlike at Keele, billing processes for customers in the trial area will need to be put in place with a wide range of suppliers. This engagement and process with suppliers is an important part of developing the progression to roll out. In parallel, the project will co-operate closely with the Future Billing Methodology project, which will provide the foundation for subsequent billing arrangements for full deployment.

How will the Project activities impact customers?
The Licensee should outline any planned interaction with customers or customers' premises as part of the Project, and any other direct customer impact (such as amended contractual or charging arrangements, or supply interruptions).
The needs of the customer are at the heart of this project. The underlying rationale for undertaking the project is to develop a method for reducing customers' carbon emissions arising from heating their homes which avoids significant disruption and capital outlay. However it is also important that in the delivery of this specific project, the needs of the customer are understood and the impact on them minimised. In order to undertake these trials it is essential that customers gas supply and appliances operate safely, reliably and deliver the performance they expect. This necessarily involves undertaking surveys of installations and appliances on the effected networks. All interactions with customers will build on the extensive experience gained through the HyDeploy project at Keele and development of best practice for engagement. An extensive engagement plan, based on the learning developed at Keele will be put in place with stakeholders and customers. This will include provision of information on the principles and benefits of the project, and the provision of communication channels for discussion and feedback to inform and assist delivery. The hydrogen blend will only be trialled on the network if HSE are satisfied that it is safe to do so and that they provide an exemption. This will only be granted if the evidence base generated and presented in the safety case and the QRA supports it. Benefits to customers in the first trial will be free testing and safety check of appliances and their installation as well as free replacement of faulty appliances. Through engagement with gas suppliers, the GDNs will provide gas billing benefits during for both sets of customers during the trial phases, ensuring that they are not in any way disadvantaged in terms of cost of gas. This process must be agreed with OFGEM, securely protecting customers interests.

What funding is being requested from each NIC? (Cross Industry Projects only)
The Licensee must outline funding that is being requested from the Electricity and the Gas NICs and include a justification for the funding split.
Not applicable. This is a Gas NIC only Project

Are there any further details the Licensee feel may support its submission?

This Project forms part of a wider roadmap towards deployment of Hydrogen on the GB gas network. Directly it draws upon the following programmes:

- HyStart (2016) NIA which provided early scoping work on the use of hydrogen natural gas blends in the UK
- HyDeploy NIC (2016) which has undertaken the foundational work relating to hydrogen blending in the GB
- FBM NIC (2016) which is seeking to establish the basis for billing gases of different calorific values.

More widely it is linked to key UK programmes

- H21 NIA(2015) and NIC(2017) which sets out a vision and seeks to clear specific barriers to the adoption of 100% conversion to hydrogen on a city by city basis, linked to the BEIS Hy4Heat programme (2017)
- HyNet NIA (2017) which defines a practical approach to adoption of hydrogen by mid 2020s through combining conversion of specific industrial users to full hydrogen, alongside blending into the wider network as proposed here.

The evidence, technical findings and enabling of early deployment established in this proposed project will contribute to these programmes.

The References in this document are:

DECC (2012) "The Future of Heating: A strategic framework for low carbon heat in the UK", 2012
NG (2012) Pathways for decarbonising heat, Redpoint & Baringa September 2012
DELTA (2012) "2050 Pathways for Domestic Heat" Delta EE, October 2012
DECC (2013) "The Future of Heating: Meeting the challenge", DECC, March 2013
GERG HIPS (2014) The European Gas Research Group," Hydrogen in Pipeline Systems"
WWU(2015) "Bridgend Future Modelling, Phase 2", WWU, Sept 2015
DECC (2016) "The Renewable Heat Incentive – A reformed and refocussed scheme"
Sansom(2015) "The challenges of decarbonising space and water heating" Dr Robert Sansom – Imperial College, July 2015
KPMG(2016) "2050 Energy Scenarios", KPMG, July 2016
BEIS(2017) "The Clean Growth Strategy Leading the way to a low carbon future", BEIS October 2017
CCC(2018) "An independent assessment of the UK's Clean Growth Strategy - From ambition to action", Committee on Climate Change, January 2018

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Job Title

Network Innovation (Future Role of Gas)