

Electricity/Gas Network Innovation Competition Screening Submission Pro forma

Notes on completion		
<p>Before completing this form, please refer to the relevant Network Innovation Competition (NIC) Governance Document(s).¹</p> <p>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.</p> <p>Ofgem will publish all the information contained within this Screening Submission.</p>		
Is the application for the Gas or Electricity NIC?	Gas NIC <input checked="" type="checkbox"/>	Electricity NIC <input type="checkbox"/>
Cross Industry Project	YES <input type="checkbox"/> <i>If yes, please fill out Cross Industry Projects section</i>	NO <input checked="" type="checkbox"/>
Funding Licensee(s)		
Northern Gas Networks		
Network Licensee Project Partners		
Network Licensee Project Partners Cadent Gas, Wales & West Utilities and National Grid		
Funding Licensee area(s)		
Northern Gas Networks		
Project Title		
H21 Network Operations		
Project Summary		
<p>This project is being conducted to expand the safety-based evidence for a 100% hydrogen conversion in the below 7 bar GB gas distribution network. H21 NIC is addressing the discrete pipes and equipment likely to be present in the GB distribution networks beyond the 2032 Iron Mains Replacement Programme. This Network Operations project seeks to address the impact of 100% hydrogen distribution from LTS offtake to the consumer's meter, encompassing the potential impact on current operational and maintenance activities, regulations and procedures. Commencing 2020, this work aligns to the BEIS Hy4Heat programme to provide substantive evidence that can be used to inform future community trials commencing 2021 onwards, which HSE will require to approve the trials. It also aims to provide insight and background information for the SGN H100 programme and will potentially also support considerations within the Cadent HyNet work.</p> <p>Consequently, the project will deliver, in combination with the H21 NIC programme, evidence that can be used to inform future policy decisions for a hydrogen conversion, providing a useful decarbonisation pathway for the GB gas networks in addition to existing green gas solutions.</p> <p>Problem: GB must determine strategies and technologies that will decarbonise heat. Penetration of gas into the heat market is very significant [circa 84%], so suitable means to decarbonise are essential to deliver against the carbon budgets set by the UK government. Work is ongoing to understand the impact hydrogen [100%] will have on existing discrete asset [H21 NIC], however there is a need to elevate the research to a network level in order that a full understanding of system behaviours, issues and responses can be delivered.</p> <p>Method: Comprehensive testing of the industry procedures to confirm if they can still be used for a 100% hydrogen network. These procedures would address both the metallic mains and polyethylene network, given future gas infrastructure will be a mix of materials post 2030.</p> <p>Solution: The project will provide comprehensive, quantified evidence across the range of procedures on the below 7 bar networks which is applicable to all network operators and supportive of other relevant hydrogen programmes, such as Hy4Heat, H100 and HyNet.</p>		

¹ <https://www.ofgem.gov.uk/publications-and-updates/version-30-network-innovation-competition-governance-documents> All capitalised terms used in this document have the meaning given to them in the respective NIC Governance Document.

Estimated Start Date		Estimated End Date	
January 2020		June 2022	
Estimated Project funding			
<i>The Licensee must provide an approximate figure of the total cost of the project and the amount of NIC funding for which it is applying.</i>			
Total Cost of Project (If Cross Industry Project provide cost split in Cross Industry section)	7,500,000	NIC funding requested	6,750,000
Is the Technology Readiness Level (TRL) of the Project at start date between 4 and 8?	YES <input checked="" type="checkbox"/>		NO <input type="checkbox"/>
What is the Problem?			
<i>The Licensee must provide a narrative that explains the Problem(s) that the Project is seeking to address.</i>			
<p>The next stage to progress potential decarbonisation of the GB gas network is to further develop the quantitative safety evidence to fully establish a safety case for hydrogen networks. There is a lack of physical evidence to support the conversion, operation and management of GB gas network infrastructure [$\leq 7\text{bar}$] distributing 100% hydrogen.</p> <p>The current H21 phase 1a and 1b is looking at the performance of the existing gas network at a discrete asset level. The next stage is to address the strategic evidence at a network level. The current H21 NIC project establishes the background performance of discrete assets and the behaviour of hydrogen in our natural surroundings. However there remains the need to research and understand the network performance and operations when converting to 100% hydrogen. This research must commence in 2020 in order to will underpin the development of a gas safety case for hydrogen and is crucial to enable the BEIS Hy4Heat programme which aims to commence community trials in 2021.</p> <p>There is a need to establish network critical safety evidence, develop and validate hydrogen gas procedures and equipment, for both new build and conversion of existing assets, integrating to wider GB hydrogen projects such as H100 and HyNet.</p> <p>Without this research there will be significant gaps in the knowledge and evidence required to inform competency, skills, process, network management requirements and the understanding how to formerly convert networks from natural gas to hydrogen and ensure continuity of supply to the customer.</p>			
What Method(s) will be used?			
<i>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 e.g. technical, commercial etc.</i>			
<p>The current H21 phase NIC looks at the performance of the existing gas network at a discrete asset level. The next stage of work is to address the strategic evidence at a network level.</p> <p>This research aims to repurpose and utilise the investments made in H21 NIC, developed at the DNV GL Spadeadam facility. The project will expand the existing gas infrastructure, increase its versatility and be able to support numerous operational scenarios under natural gas and hydrogen conditions.</p> <p>A current H21: Field Trials NIA, is carrying out a desk-based review of the key gas industry procedures for operating and maintaining the network. The outputs from this work will be used to focus the effort in this NIC. It will also provide the design for the two test areas to enable prompt commencement of the build at Spadeadam [Phase 2a] and preparation of the redundant network trials [phase 2b].</p> <p>With a focus on the BEIS ambition to commence the community trials in 2021, the following will be addressed in support of this timescale:</p>			

Method(s) continued

1. Build out Spadeadam – create the capability
2. Identify all industry procedures and validate
 - a. Analyse existing procedures,
 - b. Assess where hydrogen impacts,
 - c. Apply critical thought, evidence, modelling and bespoke testing to demonstrate safety.
3. Establish comprehensive process validation scheme to test existing procedures and amend accordingly.
4. Assess existing competency models and update based on test findings, collaborating with other stakeholders, including the GDN's, training bodies and professional institutions.
5. Identify network conversion protocols, test and review.
6. Gap analysis of industry equipment and engage with supply chain.

This work aims to complement the research being delivered by BEIS Hy4Heat programme and will maximise the use of the DNV GL funded properties within the wider test facility. This would enable the wholistic review of the implications of the network conversion.

A master test plan is being developed in the H21: Field Trials NIA. This will determine which industry procedures can be adopted without change and which will require modification to maintain current safety and competency standards. The practical testing and assurance of these will be undertaken via this H21 Network Operations NIC project.

To be able to address all of the requirements of the safety based evidence this phase 2 of the project has been further divided in to four sections:

Phase 2a)

1. Expand the test facility at Spadeadam to support the physical testing of all industry processes, procedures and operations. This will be an "extension" of the existing WBS1 site, where the 3 properties and dispersion experiments are being conducted for H21 NIC phase 1b.
2. The development of the facility will accelerate industry engagement and broaden the knowledge base of industry through direct trials and testing alongside scientific modelling.
3. Develop the processes, relationship, assurance and techniques to create a conversion blueprint suitable for use within the Hy4Heat and H100 projects.
4. As part of the testing phase industry will work from site to undertake operational techniques, prove new and established procedures and deliver outcome appraisal to capture the learning.
5. Going forward it is envisaged that the existing and new areas at Spadeadam could become a national hydrogen training facility for other hydrogen projects and preparation for the initial phases of the conversion.

Phase 2b)

1. This phase will be undertaken on in situ gas network [unoccupied], the purpose of which is bring together the results of the evidence gathered in H21 NIC Phase 1a [leakage] with the learning developed from H21 Network Operations Phase 2a, described above.
2. Via the H21 Field Trial NIA, there continues to be extensive liaison with local authorities, the MOD and private network sites to find a suitable location. The site will enable the validation of the findings in H21 NIC Phase 1 on an undisturbed set of gas assets and provide an additional layer of confidence. The results will inform the industry and BEIS of any potential issues that may present themselves during any future community trials.

Phase 2c)

The H21 NIC is updating the existing gas network Quantitative Risk Assessment for transportation of hydrogen. H21 Network Operations Phases 2a and 2b develop this further to update and refine the evidence feeding the QRA model.

Phase 2d)

As with H21 NIC, stakeholder engagement is key. This will take the learning from H21 NIC customer perception research along with similar work by Newcastle University for HyDeploy and develop informative material for stakeholders to support engagement and future roll out of hydrogen for heat.

This will be undertaken with leading researchers from academia and linking into research undertake by other key hydrogen related projects such as Hy4Heat and HyDeploy.

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. Non RIIIO-Network Licensees should indicate potential bid costs expenses

The budget for this H21: Network Operations project is dictated by the number of phases detailed below. These costs are inclusive of capital, material costs and the resource effort required to deliver the research. The total estimated costs at this stage are: £7.5M.

Phase 2a: Consists the physical expansion of the existing H21 NIC Phase 1b development at DNV GL Spadeadam to establish the flexible testing network required to deliver the research. Costs are based on modifications to the DNV GL Spadeadam site from phase 1b, supply and assembly of materials, operations and maintenance simulation. Estimated costs for this phase are £4.5m

Phase 2b: Costs to include testing at a in situ gas network [unoccupied] to provide comparative analysis to results obtained in H21 NIC Phase 1A. The funding includes site security, local hydrogen storage facilities, validation of the network and required modifications to isolate from existing network supply. Estimated costs for this phase are £2.5m.

Phase 2c and 2d: Refresh the Quantitative Risk Assessment developed through H21 NIC to account for findings across H21 Network Operations. Development of social science research to provide information to customers. Combined costs for the QRA, Social Sciences and dissemination of results are estimated at £0.5m

In parallel to the bid an NIA is underway to determine site design at DNV GL Spadeadam site providing more robust costing and acceleration of execution. Costs have been based information and knowledge gained in H21 NIC Phase 1a and 1b, the conceptual design of the sites, coupled with the expertise of the project partners.

Which specific requirements does 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)	<input type="checkbox"/>	<input type="checkbox"/>
A specific novel arrangement or application of existing electricity/gas transmission and/or distribution equipment (including control and communications systems software)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A specific novel operational practice directly related to the operation of the electricity/gas transmission and/or distribution systems	<input type="checkbox"/>	<input checked="" type="checkbox"/>
A specific novel commercial arrangement	<input type="checkbox"/>	<input type="checkbox"/>

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

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.

Converting the UK gas distribution network to hydrogen would allow decarbonisation of heat for domestic, commercial and industrial customers with minimal impact and does so with only minor changes to the heating and cooking technologies. Customer choice is maintained with no discernible changes required to customer behaviours needed to support the transition to low carbon heat. Whilst, as with all energy transitions, there will be a cost to the customer at some stage, transitioning the GB gas distribution networks to 100% hydrogen could be one of the lowest cost solutions, given the much reduced impact on existing network infrastructure and within customer premises compared to other alternatives; linked into the completion of the iron mains replacement programme in the early 2030s, costs to transition to hydrogen could be largely mitigated.

Additionally, the bulk availability of hydrogen within the UK gas grid would facilitate decarbonisation of transport through hydrogen fuelling stations and for electrical generation through decentralised and centralised technologies. Developing hydrogen for heat therefore could have far wider societal benefits, in terms of decarbonisation of other systems, the creation of new intellectual property and the increase in jobs and skills associated with the move away from natural gas systems to hydrogen.

A 100% hydrogen gas distribution network would unlock the potential for system integration between the electricity and gas networks. This would allow the onset of more renewable technology and more efficient energy balancing and higher degrees of resilience and flexibility. Furthermore, a hydrogen gas grid can provide the fuel for any future district heating system. Hydrogen, as a central energy vector for the UK, is complementary to all decarbonisation technologies. A UK hydrogen gas grid conversion would represent the biggest step forward in decarbonisation within the UK to date and deliver against existing carbon budgets.

How will the Project deliver value for money for electricity and/or gas customers?
<p><i>The Licensee must demonstrate that the Method(s) being used can derive benefits. It must also be able to demonstrate that the resulting learning can be attributed or are applicable to the electricity/gas transmission and/or distribution systems.</i></p>
<p>It is in the interests of all UK energy customers that the challenge of the Climate Change Act is delivered utilising the optimised solution / combinations of solutions. Failure to deliver the carbon reductions in an optimised way could lead to significant increases in customers' bills, disruption in the homes and the highways and potentially removal of the energy choices that customers enjoy today (electric and gas). Moreover, a move to deliver all GB energy via one system will lead to a marked reduction in resilience {eggs in one basket}, and potentially higher longer-term costs to overcome the lack of diversified energy for heat, transport and power and to ensure our energy infrastructure maintains levels of resilience currently delivered by GB gas infrastructure.</p> <p>Re-purposing the gas distribution network with hydrogen has the potential to ensure the continued, indefinite use of our national gas infrastructure in a low carbon format. This ensures customers of tomorrow can have the same energy choices as customers of today. It ensures the systems, processes, technologies familiar to gas customers remains available, simplifying the pathway to decarbonisation and removes the need for complex and high cost retrofit activities within the premise to enable alternative non gas solutions.</p> <p>Additionally, if hydrogen conversion is undertaken in the UK gas grid it will avoid the high costs associated with stranding the UK gas infrastructure – a multi-billion-pound asset.</p> <p>The evidence which will be provided will be transferable to all gas networks. The work is being designed to cover the broadest range of below 7 bar gas assets whilst keeping costs to a minimum. The collaborative nature of the project negates the challenges of knowledge transfer between GDN's as all will be actively involved from the start.</p>
How will the Project generate knowledge that can be shared amongst all relevant Network Licensees?
<p><i>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 will be disseminated.</i></p>
<p>This is a collaborative project between all GB Gas Transmission and Distribution Networks and will be delivered by a cross industry project team and multi stakeholder steering / stakeholder board. Outputs from the work will inform the Hy4Heat programme, SGNs' H100 Programme, Cadent's HyNet and the emerging hydrogen projects from National Grid.</p> <p>The existing H21 NIC project is working collaboratively with the BEIS Hy4Heat project to enable both parties to join forces at the Community Trial stage.</p> <p>The key information from the project will also be shared with the Hydrogen Transformation Group.</p> <p>Knowledge Generated.</p> <p>The purpose of the project is to provide unique and referenceable data for GB gas industry and other stakeholders. The work will validate all industry procedures applicable to the below 7 bar systems, will develop the scientific approach to extrapolate findings across GB infrastructure and deliver the supportive evidence required to inform any decision to move to occupied community trials, though the BEIS Hy4Heat programme.</p> <p>Knowledge dissemination is integral to the project execution. The project has support across the wider gas industry. Building on the 'H21' brand the project will progress with a detailed communications strategy and stakeholder plan. This will involve continuous presentations throughout the project at major conferences, round tables and various other events and a comprehensive public domain report and film which will be shared at a launch event at project completion (see H21 end of year film on the H21 website).</p>

Does the Project conform to the default Intellectual Property Rights (IPR) arrangements set out in the NIC Governance Document?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>
<i>By selecting NO, the Licensee is indicating that it 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 IPR arrangements.</i>		
The purpose of this project is to provide insights and data for all Network Licensees and wider stakeholders, and 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?		
<i>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.</i>		
<p>The use of 100% hydrogen in an existing gas network has not been performed. The current H21 NIC phase 1 is addressing leak tightness of the assets in the networks in a remotely operated environment but the demonstration of operational and maintenance procedures and equipment has not been tested and neither has the gained evidence been scientifically analysed for application at a GB network level.</p> <p>The testing within H21 NIC phase 1b will also determine what level of leakage is likely for metallic mains distributing 100% hydrogen, how hydrogen migrates once escaping confinement, what will cause ignition within a range of hydrogen concentrations and the extent of impact of any ignition.</p> <p>This NIC project will develop on from these results by carrying out a full review and undertake physical testing of the industry procedures. The current field Trials analysis NIA project will advance the Master Test Plan for phase 2, selecting the relevant of industry procedures and techniques to review. It will utilise scientific methodology to imply the learning to the GB network, to deliver findings that are replicable and relevant in most situations and locations. This proposed H21 Network Operations project will enable the GB gas industry to deliver the required knowledge and competencies supporting any move towards the occupied community trials with the BEIS Hy4Heat project and provide valuable insight, literature and methodologies to support future H100 and HyNet research.</p> <p>Without the knowledge of analysing industry procedures and then physically testing the same, with 100% hydrogen, it would not be possible to deliver the required evidence and updated GDN Safety Case [Hydrogen] to support any occupied community trials.</p> <p>All the individual technical aspects of a hydrogen conversion can be evidenced across the world today. However, the most significant requirement is to provide the quantified safety evidence that a hydrogen gas grid in 2032 represents a comparable risk to a natural gas grid.</p> <p>Providing this further safety-based evidence must be led and managed by the GB gas industry, supported by specialist partners, who have the expertise and experience to undertake the work safely, effectively and efficiently. There is no provision within business as usual operations in the RII0-GD1 price control period for networks to undertake such an extensive project. The rationale for the project is to enable a 100% hydrogen pathway to be de-risked. This will facilitate the UK government to make strategic policy decisions to enable what could be the lowest cost, lowest disruption, and most technically credible major decarbonisation solution. This would be in the interests of all GB gas customers and the wider UK to meet its carbon reduction commitments.</p>		

How were project Partners, external resourcing/funding identified, and what are their respective roles in the Project?
<p><i>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.</i></p> <p><i>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.</i></p>
<p>This project is in collaboration across all UK gas distribution networks along with specialists from HSL and DNV GL who will have an engrained knowledge of the H21 Phase 1 NIC and be able to apply this into H21 Network Operations NIC.</p> <p>Northern Gas Networks is the lead funding licensee & project sponsor. NGN is leading the bid based on the networks experience delivering the H21 NIC project and its associated H21 roadmap which forms the basis of this project. NGN will provide 25% of the mandatory 10% funding requirement.</p> <p>Cadent will provide 25% of the mandatory 10% funding requirement and will form part of the project delivery team.</p> <p>Wales & West Utilities Networks will provide 25% of the mandatory 10% funding requirement and will form part of the project delivery team.</p> <p>National Grid will provide 25% of the mandatory 10% funding requirement and will form part of the project delivery team.</p> <p>Scottish and Southern Gas Networks will provide resources working with the H100 project to provide technical support to form part of the project delivery team.</p> <p>DNV GL: Global Technical Advisor to UK Oil and Gas Industry- Bid production support, project management support, quantified risk assessment and testing. Building on the test facility at Spadeadam, phase 2a will be based at Spadeadam.</p> <p>Health and Safety Laboratory (HSL): The commercial arm of the HSE and one of the UK's foremost health and safety experimental research establishments. Specific understanding of the issues that HSE need to see addressed in this field, oversight of the experimental programme, testing and analysis of the emerging evidence base.</p> <p>Academia: Will provide support for customer engagement strategy across the project and baseline and subsequent development of public opinion to decarbonisation / hydrogen strategies as the project progresses.</p>
Will the Project require any derogations or exemptions?
<p><i>The Licensee should outline if it considers that the Project will require any derogations, exemptions, or changes to the regulatory arrangements.</i></p> <p>The phase 2a testing will be undertaken at the test facility at Spadeadam, which is isolated from the network and a remote location. For phase 2b the testing would only be conducted on isolated mains or controlled site environments, it will not have an end use customer impact. As such testing will be managed through development of a comprehensive safety management system. It is not anticipated that any derogations to the regulatory arrangements will be required.</p>

How will the Project activities impact customers?
<p><i>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).</i></p>
<p>This programme will not have a direct effect on customers in terms of end use appliances.</p> <p>Phase 2a of the project will be based at the DNV GL site at Spadeadam. This will provide isolate customers from any disruption or impact. The project will create some disruption in the streets when removing mains any additional assets for testing. The project will, where possible, try are reuse asset that have previously been removed as part of the original H21 NIC project, residing at HSL Buxton site and is repurposing the developed asset at the DNV GL facility located at Spadeadam.</p> <p>When removing mains in the street for testing customer engagement will be managed as part of business as usual processes adopted day to day for the iron mains replacement programme. For phase 2b, field testing a specific customer engagement plan will be developed, working with local authorities, to ensure minimal disruption and confidence in the works for any customers in the identified small field trial areas. Where possible field testing will use a site with minimal or no customer impact, e.g. decommissioned holder sites, derelict / demolished council owned sites. The customer engagement plans will include provision of information on the principles and benefits of the project, and communication channels for discussion and feedback to inform and assist delivery.</p> <p>In addition to the core project team additional support for the customer engagement strategy will be provided by Leeds Beckett University based on their findings in Phase 1. This work will continue to understand public opinion to decarbonisation / hydrogen strategies as the project progresses and will develop specific material to be used to better inform customers on the project, the role of hydrogen in a decarbonised energy system and the possible timelines for change.</p>
What funding is being requested from each NIC? (Cross Industry Projects only)
<p><i>The Licensee must outline funding that is being requested from the Electricity and the Gas NICs and include a justification for the funding split.</i></p>
<p>N/A</p>

Are there any further details the Licensee considers would support its submission?	
<p>For details on the original H21 NIC project please go to the Northern Gas Networks website and type in 'H21' to the search bar. This provides access to the year Ofgem report, yearly summary and H21 NIC film (4 minutes).</p> <p>Within the UK Government's Clean Growth Strategy, it states about the clean growth challenges including the use of hydrogen - "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."</p>	
Contact Information <i>(Cross Industry Projects can provide details for up to two contacts)</i>	
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