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NIA Project Registration and PEA Document

Date of Submission

Jun 2023

Project Reference Number

NIA_NGN_421

Project Registration

Project Title

Domestic Hydrogen Sensor Research

Project Reference Number

NIA_NGN_421

Project Licensee(s)

Northern Gas Networks

Project Start

June 2023

Project Duration

0 years and 9 months

Nominated Project Contact(s)

sstone@northerngas.co.uk

Project Budget

£181,504.00

Summary

Hydrogen has many similar characteristics to that of natural gas but does not behave in the same way. To address these different characteristics and to increase customer confidence in hydrogen being used in domestic properties, a reliable hydrogen sensor device which can identify an escape within the home is required. An appropriately certified Domestic Hydrogen Detector/Sensor does not currently exist for use in the UK. This project sets out to perform a detailed study into the individual technology components and/or integrated solutions required for creating a 'best in class' domestic hydrogen sensor device. The project will take into consideration the performance of the following components, both individually and as part of an integrated hydrogen detector solution/system:

Existing and emerging hydrogen gas sensor technologies and concepts

Communication and remote interconnectivity solutions e.g., contacting a remote emergency response centre in the event of alarm etc.

Power management strategy.

Battery selection and longevity

Third Party Collaborators

Bohr Limited

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Problem Being Solved

As progression towards a live village trial draws near it is intended that the current natural gas energy system will transition into a system that is fuelled by 100% hydrogen gas. Hydrogen has many similar characteristics to that of natural gas but does not behave in the same way. To address these different characteristics and to increase customer confidence in hydrogen being used in domestic properties, a reliable hydrogen sensor device that identifies an escape is required. An appropriately certified Domestic Hydrogen

Detector/Sensor does not currently exist for use in the UK.

Method(s)

The proposed project is to develop a detailed design specification and design pack for a domestic hydrogen detector. As part of the R&D for this project, numerous sensing/detection technologies, along with a variety of communications protocols, will be trialled to identify the optimum solution. The project will conclude with a recommendation report that details the findings of the literature review, critical analysis, and laboratory-based assessments for the best/optimal integrated technology solution (sensor, battery, connectivity etc.) that can then be used as a Performance Specification to support a future ITT for procurement of a commercial H2 detector solution. The data sources of all literature reviews will be referenced and audited for latest versions. There will be review and challenge of manufacturer's data claims throughout the project. Due to the nature of the work, there will be no data privacy issues.

The project will be broken down into the following work packages, and will conclude with detailed design drawings and a written report that has findings and recommendations on:

- Sensor Technology Desktop Study
- Communications Design & Development
- Sensor Procurement, Development & Testing
- Communications Build & Testing

Scope

The project will lead to the design of a domestic hydrogen sensor device, similar in style and size to existing, ceiling mounted, indoor smoke and CO detectors.

There have been tight financial targets set for the consultant delivering this commission. The current solution proposed for Village Trials is an industrial application that costs £1,000 per unit. This project aims to reduce unit costs down to £100 - a very large saving for the taxpayer during Village Trials, as well as consumers, who will benefit during UK-wide roll-out.

The scope covers:

- Sensor Technology Desktop Study
- Detailed study, review, understanding and testing of various hydrogen sensing technology at component, and where appropriate at the device level
- Communications Design & Development
- Detailed study, review, understanding and testing of various communication protocols and battery specification/power consumption
- Detailed design for recommendation
- Sensor Procurement, Development & Testing
- Procure recommended sensors and integrate into test rig in laboratory conditions
- Written report comparing sensor technologies performance
- Detailed design for recommended solution
- Communications Build & Testing
- Recommended Design Specification
- Design for both a 'dumb' (CAT B) and 'smart' (CAT A) hydrogen detector
- Detailed Final Recommendation Report summarising the various factors influencing the selection of one integrated hydrogen detector solution against alternative technology solutions.
- Detailed design drawings

Objective(s)

The end goal of the proposed solution is a Technical specification document for an integrated domestic hydrogen detector. The detector, which will be similar in appearance to a smoke or carbon monoxide detector, will have an integrated battery with a minimum of 1 year power storage (stretch target of 5 years), a hydrogen in air sensor, an audible alarm, and a flashing light. The detector will also be designed so that it can incorporate additional functionality such as the ability to send notifications to the homeowner and to the gas network (plus additional 3rd parties if required). The end result of the project will take into consideration the existing apps on the market available for the device to communicate with, rather than stand-alone. This may form part of the criteria for down selection of communications.

In addition:

Consideration will be given for the most cost effective and reliable methods of having multiple detectors in a single household. Multiple sensor technologies will be tested and, as a minimum, will all meet or exceed the BSEN50194 standard, including the revisions to be made to this for hydrogen (currently ongoing)

A full study and evaluation of the various possible communications protocols will be performed (laboratory testing), as well as live testing in dwellings.

Testing and optimisation of the battery life/performance will be completed

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The project will support vulnerable customers in a variety of ways. Firstly, the analysis being undertaken by the Supplier is driven towards the affordability of the final product. One of the set objectives is to ensure that the final recommended product does not come in over £40 for a dumb unit, and £100 for a smart unit. This will allow procurement to be within the financial reach of customers.

In addition to affordability considerations, the objectives for the commission set the inclusion of visual and acoustic aids to let vulnerable customers know that the detector is in alarm. The support to vulnerable customers will go even further by facilitating automated connectivity to a call centre. This will mean the customer gets a rapid FCO response without any interaction with the detector.

Success Criteria

The project will be deemed a success if:

- A detailed design and specification that will facilitate the development of an accurate and reliable hydrogen detection device / monitor.
- A recommendation report that details the findings of the literature review, critical analysis, and laboratory-based assessments for the best / optimal integrated technology solution.
- The detailed design solution will have minimal impact on the end-user.
- The detailed design solution of the final product needs to be within budget of bill payers, notionally a maximum of £100 per unit for the smart unit, and £40 for the dumb unit.
- Reliable and consistent device connectivity (external communications to FCO centre, and internal connectivity between other devices in the home - potentially other / similar hydrogen gas detectors e.g., multi-device installations).
- Simple for customers to use / operate / understand.
- Easy / cost efficient to manufacture.
- Capability of multiple detectors to be able to communicate to an independent smart meter in each home, to allow detection all over the home.

Project Partners and External Funding

Northern Gas Networks

Cadent

SGN

Wales & West Utilities

Bohr The project will be wholly funded via NIA.

Potential for New Learning

The main new learning around this project will be on the development of the sensors and particularly the packaging of the sensor element into a domestically applicable sensor housing. The fundamental aim of the project is to establish the best possible design for a new Hydrogen Detector based on the best possible individual components.

Scale of Project

This project plays a key safety role across 'streams' (up and downstream) and plays part in any quantitative risk assessment (QRA) required for the Village Trials.

The key deliverables on the design will also facilitate a scope of mass producing a sensor device to be used in a national roll out.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The project is predominantly a laboratory-based project taking place at Bohr's locations within the UK. However, there will be a level of domestic experimentation for the communications infrastructure.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External Costs:

Total cost = £181,504.00

Cadent = £90,752.00

NGN = £22,688.00

WWU = £22,688.00

SGN = £45,376.00

Internal Costs

Total cost = £50,896.60

Cadent = £ 7576.38

NGN = £16,809.59

WWU = £7,562.67

SGN = £15,124.00

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The project endeavours to support the wider roll out of hydrogen for domestic heating on both a trial and conversion basis. The work undertaken will enable appropriate use of technology to support management of mitigation measures for hydrogen use within the home.

How the Project has potential to benefit consumer in vulnerable situations:

This project will deliver a design specification for a fit-for-purpose domestic hydrogen detector. The design specification will be developed with consideration of an affordable price point that will benefit consumers. The design will incorporate both an audible alarm and a light which will alert all customers in the event of an escape. It will also allow remote communications so that third parties can respond to hydrogen detection,

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

This is for Development or Demonstration Projects, not required for Research Projects. It should be (Base Cost – Method Cost, Against Agreed Baseline) and include a description of the recipients of the benefits.

The single most important benefit to the client is that this project will help enable the hydrogen transition. Without a fit-for-purpose domestic hydrogen detector, the introduction of hydrogen as fuel in domestic properties is currently considered (or perceived) an increased risk compared to Natural Gas.

Please provide an estimate of how replicable the Method is across GB

This must be in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

It is anticipated that this solution can potentially support the upcoming Hydrogen Village Trials (HVT) which will prove potential roll out of 2000-4000 units. If successful and a high use hydrogen future policy decision is taken, then the solution could be rolled out across all domestic premises that utilise hydrogen.

Please provide an outline of the costs of rolling out the Method across GB.

The project scope challenges Bohr to ensure the end specified device is a maximum of £100 per unit for the smart unit, and £40 for the dumb unit.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system
- A specific novel commercial arrangement

RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The main new learning around this project will be on the development of hydrogen sensors and particularly the packaging of the sensor element into a domestically applicable housing. The fundamental aim of the project is to establish the best possible design for a new Hydrogen Detector based on the best possible individual components. This will lead to full understanding of the global status of the hydrogen detector market, including products that are not currently commercially available. Further, the overall solution will be developed to optimise battery life in conjunction with delivering increased data to the end user versus traditional alarms used. While industrial size and cost units for hydrogen detection exist, these are not appropriate for the domestic market; further research is necessary to understand the best possible options available

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

- Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

There is no certified domestic hydrogen detector in the UK. On top of this, there is a desire to produce a detector unit that has a more advanced communication system than detectors usually have.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other

Network Licensees.

There is no certified domestic hydrogen detector in the UK. On top of this, there is a desire to produce a detector unit that has a more advanced communication system than detectors usually have.

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

An appropriately certified Domestic Hydrogen Detector does not currently exist for use in the UK, so the driver/scope of this project is a detailed study of the 'best in class' individual technology components and/or integrated solution appropriate for the proposed application.

Specific consideration shall be given to the performance of the following hydrogen detector components, both individually and as part of an integrated detector solution/system. The optimal combination of these performance criteria does not currently exist in a UK certified detector:

- (i) Existing and emerging/new hydrogen gas sensor technologies and concepts
- (ii) Communication and remote interconnectivity solutions e.g., contacting a remote emergency response centre in the event of an alarm etc.
- (iii) Power management strategy
- (iv) Battery selection and longevity.

Relevant Foreground IPR

All IPR stays with GDN's and as such no change to exiting market arrangements, the project focussing on no regrets changes and the use of exiting processes / frameworks where possible in order to ensure that financial impacts on customers are kept to a minimum.

Data Access Details

All of the measured information from the customer energy village will be available on request to maintain an open approach to sharing. Information related to the customer conversations will be subject to protections in accordance with current legislation and will be managed by National Energy Action.

For all data access requests, please follow the guidance set out in Northern Gas Networks Innovation Data Sharing Policy.

<https://www.northerngasnetworks.co.uk/ngn-you/the-future/our-funding/>

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

The use of hydrogen for domestic heating is not a business function of the networks at the moment. The analysis and appraisal of using hydrogen in the UK has been requested by DESNZ, and the development of a domestic detector is seen as a major mitigation.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

This project is not part of the networks usual business functions. Without the development of a domestic hydrogen detector the technical, operational and regulatory impacts of decarbonising the UK networks could be severely hhampered. By developing an affordable, mass-produced hydrogen detector (with advanced connectivity) the UK stands a better chance of achieving net zero by 2050.

This project has been approved by a senior member of staff

Yes