Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Jul 2022

Project Reference Number

NIA_NGN_359

Project Registration

Project Title

Project Helix

Project Reference Number

NIA_NGN_359

Project Licensee(s)

Northern Gas Networks

Project Start

May 2022

Project Duration

1 year and 11 months

Nominated Project Contact(s)

Steve Dacre (sdacre@northerngas.co.uk)

Project Budget

£100,100.00

Summary

The number of deaths reported annually due to carbon monoxide poisoning is between 30-60; with 53 reported in 2019 by the Office of National Statistics. About 4,000 people attend A&E with suspected Carbon Monoxide (CO) poisoning and of these 200 people are admitted to hospital every year. CO related incidents constitute 10% of calls to fire services. Lower levels of less than 70 parts per million (PPM) or undiagnosed carbon monoxide poisoning produce lasting neurological damage, memory loss and difficulties in concentration.

Third Party Collaborators

Affotek

Energy Innovation Centre

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Problem Being Solved

The industry and manufacturers have been selling CO detectors and related products for a number of years. There are a number of commercially available CO alarms that detect CO levels in the atmosphere of where the alarm is placed.
There are new entrants from Google and Honeywell that connect to phones. It is unclear at what level of CO these new entrants' function.
The 'first line of defence' has always been to encourage gas appliances are serviced and inspected annually by a Gas Safe Registered Engineer. The gas distribution networks operate the gas emergency service to respond to CO alarms in order to make the situation safe.
There is no self-diagnosis option for carbon monoxide poisoning as diagnosing carbon monoxide poisoning is a combination of

recognising signs and symptoms as well as measuring the amount of CO in the bloodstream.

Further research had shown availability of sensors to detect carbon monoxide in addition to vital functions. These minute sensors can be combined and programmed to measure activity levels similar to Fitbit or Apple Watch. Such sensors would measure CO in excess of 15 PPM whereas the wall mounted and portable would measure presence of CO 40-50 PPM over an eight-hour period and 400 PPM for 4 to 15 minutes. Currently, there is no way to accurately determine levels of CO in the bloodstream when a customer solely relies on a CO alarm to trigger warnings. Battery levels and condition of these alarms can produce false alarms, or no sound at all. In addition, these CO alarms are commonly installed not in accordance with the manufacturer recommendations, and one could argue that if not used as intended it is equivalent to not having one in the home at all. Customer worn sensors will eliminate this.

Method(s)

Carbon Monoxide (CO) is a colourless, odourless, tasteless gas that is known to be a product of incomplete combustion of natural gas.
Named the silent killer by former chief medical officer Prof Sally Davies. It is reported that between 30 and 60 people die in the UK as a result of carbon monoxide poisoning, with increasing numbers throughout the world.
The aim of this project is to develop a wearable device (intended to be a ring) that will combine CO detection along with other vital functions such as heart rate, blood pressure, respiratory rate and blood oxygen level.

With regards to measurement and data quality from the sensors used in the devices, these will conform to BSI, MHRA & UKCA Kitemarking with final standards and correct calibration at the time of installation. Quality assurance will be confirmed and undertaken by Semefab.

The Centre for Processing Innovation at Sedgefield chose the health sensor made by a Norwegian semiconductor for its reliability. The CPI is the Government appointed agency for medical devices approvals. The Bosch sensor was chosen as it has recommended sensors that come with CE certification. It is now more stringent as the new regulations require software to be certified too.

The Academic Health Sciences Network NE & Cumbria will make an independent assessment of the functionality. They would test the device accuracy and reliability.

It is envisaged there will be multiple stakeholders benefiting from this technology such as pregnant women (as studies indicate the increase of foetal birth defects following carbon monoxide poisoning), elderly consumers (as approximately 3.5million over the age of 65 live alone) and employers (in the prevention of worker fatigue and CO exposure).
Supported by Brunel University, Affotek has conducted a preliminary design conceptualisation and initial market research.
Additionally, the Centre for Process Innovation at Sedgefield has carried out a ‘Feasibility study and a Road Map to Prototyping’
This would place the device currently at TRL 3 and developed to TRL 8 as part of this project.

Scope

Net benefits for consumers are:

Health and Safety – Early detection of the health risks associated with carbon monoxide
Community – Improved public awareness of the health risks linked to carbon monoxide poisoning alongside enhanced detection and response to exposure and improved confidence and understanding of the issues and causes
Environmental – Indirectly related with the construction of the devices maximising the use of green and recycled materials.
Individual customers – individuals, carers, family will appreciate the protection such a device will deliver with measures to prevent ill health, and reassurance with use
Carbon reduction – Customers may have an attitude change to activities that create CO, as education of what causes CO will be received.

In Scope
This project will develop a prototype device to validate the technology via the following three stage approach:

Stage 1 –
Validate the device by fixing sensors and prove overall function and application in a laboratory
Stage 2 –
Developing an algorithm, a user interface (app) and testing its’ functionality with the device and refine.
Collaborate with the Academic Health Sciences Network NE & Cumbria to gain an independent assessment of the technology function
Stage 3 –

Test the ring and the app with a range of volunteers, in collaboration with the Academic Health Sciences Network NE & Cumbria, and undertake further studies to better understand the future commercial viability.

Out of scope

This project will not extend the range of sensing capability of the technology as this is seen as potential future development to extend consumer benefit.
This project will not create a market ready product
This project will not substantiate the future commercial model for such a device

Objective(s)

Stage 1
Engage stakeholders to determine if the device would be worn, with the define device type and style based on a range user cases (e.g., ring, watch, badge etc). A chosen design agreed by project steering group based on stakeholder feedback will then be developed and will aim to satisfy the broadest most application / use case.
Explore and validate different sensors (CO levels in atmosphere, carboxyhaemoglobin in blood), and from this a specific model of sensor will be evaluated and chosen for development.
Define device capabilities (types of activity measurement, duration and how this information is portrayed to user), with a prototype device that will measure atmospheric CO. The sensors will allow the device to measure heart rate and respiratory rate to calculate the intensity of activity and duration. A definition on how the device will display this information in a useful format for the user will also be established.
Manufacture prototype devices: 2 prototype devices will be produced that detect CO & fatigue with application[s] created to capture CO poisoning and fatigue in volunteers.

Stage 2
Undertake testing of functionality in simulated settings, for instance detection of CO, heart rate, respiratory rate, blood pressure, blood oxygen levels and fatigue.
Develop a mobile application to interact with the device to present useful information to the user and allow analysis of results
Undertake independent testing and quality assurance of the functionality, wearability, the mobile application and produce a report summarising the findings.

Stage 3: Field Trial:
-with our volunteers carry out user testing for:
Fatigue
exposure to CO
Heart rate detection
Respiratory rate detection and activity
suitability of the design / acceptability
Overall functionality
Alarm indications
ease of use of the application
Overall user satisfaction

Consumer Vulnerability Impact Assessment

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register.

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to improve the exchange of information between networks and immediate health and safety in the home have been made in carrying out this assessment.

Success Criteria

The project will be deemed a success if the following are achieved:
Minimum Criteria Description
Detects Levels of CO <50 PPM down to 15PPM + Heart Rate + Respiratory Rate + Blood Pressure: Continuous function

Detects Muscle Fatigue & Hours of Activity+ Muscle Activity + Increased Heart rate + Respiratory Rate + Muscle movement continuous function

Desirable Criteria Description (Could)
Detection of Pollutants in Addition to CO
Determine / detect other indicators of fatigue
Support the health of pregnant women as an output from the findings from the IPPCO whitepaper due to conclude in December 2022 which will identify those most a at risk of low levels of CO poisoning

Project Partners and External Funding

This project is funded via the NIA funding mechanism
Northern Gas Networks [50% contribution]
Cadent [50% contribution]
Affotek [technology developer]
Energy Innovation Centre

Potential for New Learning

Lower levels of Carbon Monoxide can be harmful, fatigue causes accidents and sickness (increased sickness levels, accidents, and death). Low CO levels at 10PPM are harmful to an unborn child and alert level set at LOW CO for pregnant mothers.
Has the potential to unlock other applications for this type of technology, specifically wearable tech and how this is perceived by our customers and the appetite to embrace new solutions which are designed with the safety at the heart of design.
Potential for further development of the solution and its algorithms which enhance health and development of the user.
Has the potential to identify low level exposure to Carbon Monoxide in settings outside of the home.
Development of sensors for wearable technology to inform medical decisions.
Identify samples of individuals who are exposed to low levels of CO without prior knowledge.
An understanding of the market appetite for wearable technology of this nature.
Establish links to NHS trusts within NGN and Cadent networks
Gain input from NEA regarding the outputs / findings of the project

Scale of Project

The project is mostly made up of R&D elements, this technology is new with some of the sensor elements untested at this stage. Wearable technology of this type has not been developed before; this will be tested using the two prototype rings which will be produced as part of the project and tested with users as detailed in the project plan.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Northern Gas Networks and Cadent geographical areas

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Total external project costs £91,000

NGN External Cost: £45,500
NGN Internal Costs: £4,550

Cadent External Cost: £45,500
Cadent Internal Costs: £4,550

Total project cost: £100,100

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

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

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

N/A

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

The aim of this project is to develop a wearable device (for example a ring / watch / bracelet etc) that will combine CO detection along with other vital functions such as heart rate, blood pressure, respiratory rate and blood oxygen level.
It is envisaged there will be multiple stakeholders which could benefit from this technology such as pregnant women (as studies indicate the increase of foetal birth defects following carbon monoxide poisoning), elderly consumers (as approximately 3.5million over the age of 65 live alone).

The project is to build a prototype wearable technology which would protect any wearer from the dangers associated with Carbon Monoxide. These dangers include fatigue and the effects of suffering from this such as trips, slips and falls due to vertigo, dizziness, feeling faint and lack of co-ordination. There is a potential to detect this happening before the occurrence takes place, or to detect that a consumer has slipped, tripped or fallen.

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

N/A

Please provide a calculation and/or description of the expected benefits of the solution

Using the NGN CBA model, it was calculated that the SROI has a score of 76% return on investment. This is a positive SROI calculation due to how the project can affect consumers, the NHS, other emergency services and the relationship between vulnerable customers and ill health.
Prevention of death, disability and health welfare for users is a clear impact indicator in reaching a high SROI score.
There are significant unquantified benefits as a result of this project such as increased vulnerable customer mental and physical wellbeing from having the reassurance of the monitor and better managed fatigue etc. It is likely to improve productivity and reduce work/medical appointment absences. In addition, this project is likely to generate economic benefits for the region and UK more widely through Gross Value Added improvements, job creation and export opportunities from the creation of a viable and cutting edge product and collaboration with universities.

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

This is an R&D project, which is to develop wearable CO and fatigue detection technologies, further applications which could be identified through the project progression.
Further development of the product could enable societal adoption and not necessarily limited to those networks the project is run on.
The end product could be bought and distributed across GB as a simple purchase and use. Special training will not be required to use the device other than in-box instructions for the wearer.
Whilst this technology has a firm customer vulnerability focus, it does also have the potential for wider applications into industrial settings where staff maybe exposed to the environmental risks this device is aiming to protect against.

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

The costs of rolling out the method across the GB is unknown at this time as the project will only go to TRL 8.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☑ 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

This project will develop new wearable technology which aims to deliver enhanced detection of CO and fatigue through to TRL8. As such follow-on development will be required by the vendor to develop a product and commercial, cyber security and data protection models. A successful outcome for this project will enable that forward investment and as such support broad adoption of the technology across the UK social and industrial sectors. The learning developed through this project will inform and shape future work in the wearable tech space for Network Licensees as well as further the understanding and knowledge base available for organisations such as the NHS and non-governmental organisations supporting customers in vulnerable situation

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. Networks must explicitly mention similar projects that they have considered and how these differ.

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

This project seeks to develop a first of a kind technology through innovation to establish a small number of prototypes. This novel arrangement is not seen in other wearable systems and as such has not been developed through NIA innovation and governance previously.

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

Network Licensees.

N/A

Additional Governance And Document Upload

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

This project will develop a new non-invasive technology to detect very lower levels of CO in the human bloodstream which isn't possible with the technology that exists in the marketplace today. The currently TRL for the sensor system is TRL3 and so requires innovation support to progress the technology through to TRL8.

Relevant Foreground IPR

The project and the resultant outcomes/deliverables will conform to the default treatment of IPR as set out under the agreed NIA Governance (where the default requirements address two types of IPR: Background IPR and Foreground IPR)

Data Access Details

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 a part of it's business and usual activities

Development of this technology from a low TRL level [3] means this work has a has a higher risk of failure than would be acceptable to fund as normal Business as Usual activities. The project is also focusing on wider societal impact, to protect customers in vulnerable situations.

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

Due to the technology which needs to be designed, built and tested. The NIA funding stream is intended to reduce risk on the GDN's as this is uncharted territory with wearable technology in this specific area.

This project has been approved by a senior member of staff

☑ Yes