

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

Aug 2017

### Project Reference Number

NIA\_NGN\_218

## Project Registration

### Project Title

Alternative Pre-Heat System

### Project Reference Number

NIA\_NGN\_218

### Project Licensee(s)

Northern Gas Networks

### Project Start

September 2017

### Project Duration

0 years and 6 months

### Nominated Project Contact(s)

Gareth Payne

### Project Budget

£43,152.00

## Summary

The scope of this project is to explore if materials doped with Graphene Nanoparticles can be used to produce low power Very Low Voltage (VLV) heating elements for pre-heating gas. This is an early stage feasibility assessment, but if successful will lead on to further projects. The project will be done in five stages as set out in the objectives below.

## Third Party Collaborators

Haydale Composite Solutions

## Nominated Contact Email Address(es)

innovation@northerngas.co.uk

## Problem Being Solved

When gas is reduced in pressure the Joules-Thompson effect causes a temperature drop of 0.5°C for each 1 bar drop. When the gas temperature and thus that of the conveying pipework and equipment falls below 0°C problems arise. The temperature below ground is very constant at about 5°C, thus pressure drops of greater than 10 Bar result in the gas temperature dropping below zero.

This degree of pressure reduction and subsequent temperature loss requires the GDNs to heat the gas prior to the pressure reduction process, known as Pre-Heating.

The challenge is to develop a modern innovative Pre Heat system which can operate using low power (24V) and thus be backed up using the existing Very Low Voltage (VLV) distribution systems on site. In an effort to move towards a lower carbon future NGN are already considering alternative methods of providing or generating power for Above Ground Installations. The utilisation of VLV methods of Pre Heating the gas would also contribute to this agenda.

## Method(s)

Haydale Ltd will carry out all design, prototype building, testing and report writing activities. NGN will provide technical guidance and design review throughout.

All testing will be done under controlled conditions at Haydale's Laboratory facility.

## Scope

The scope of this project is to explore if materials doped with Graphene Nanoparticles can be used to produce low power Very Low Voltage (VLV) heating elements for pre-heating gas. This is an early stage feasibility assessment, but if successful will lead on to further projects. The project will be done in five stages as set out in the objectives below.

## Objective(s)

### Stage 1 – Target Design Specifications

NGN will provide Haydale with details of existing equipment and pre-heat requirements for research. The collaborative outcome of this stage will provide the detailed design specifications.

### Stage 2 – Top Level design description and calculations

Haydale will produce one or more theoretical designs will be examined using simplified assumptions and calculations made to demonstrate how the above requirement can be met.

### Stage 3 – Design Options and Risks

A review of the design will be undertaken with input from several engineers to examine further options and risks in moving forward with a full-scale development.

### Stage 4 – Lab Scale Demonstrator

A lab scale model will be built and tested to demonstrate critical operational capability of the technology to meet the design requirements.

### Stage 5 – Report and Recommendation

A full report will be written detailing the outputs and findings of the above stages, efficiency analysis, comparison to existing pre-heating methods and cost benefit analysis, as well as recommendations for any further development as necessary.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

The following will be considered when assessing if the project has been successful:

- Existing design and specification requirements
- Design options and risk assessment framework
- Successful lab demonstration of selected design option
- Final report highlighting successes, lessons learnt, options and recommendations for next stage development, efficiency comparison against existing pre-heating systems, cost benefit analysis.

## Project Partners and External Funding

n/a

## Potential for New Learning

n/a

## Scale of Project

This is an early stage feasibility assessment/research project. The potential of Graphene technology and thus and subsequent projects should this one be successful could benefit the whole gas industry.

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL4 Bench Scale Research

## Geographical Area

The research and laboratory testing will take place at Haydale's facility in Carmarthenshire, Wales.

## Revenue Allowed for the RIIO Settlement

N/A

## Indicative Total NIA Project Expenditure

NGN external costs £32,364

NGN internal costs £10,788

NGN total project costs £43,152

## 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:

n/a

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

n/a

### 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)

This is a research project but has the potential if successful to lead to field trials and a new type of pre-heat system using Very Low Voltage (VLV) power. The anticipated new system would negate the need for expensive assets (Electric Generators) and the associated maintenance costs. This technology could be implemented across the gas distribution sector which would provide tangible savings that could be passed on to customers.

#### Please provide a calculation of the expected benefits the Solution

This is a research project.

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

Due to the early TRL of this project we are unable to provide an estimate.

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

As above

### 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 trialed 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

Each network will be able to see the potential benefits of using graphene as an alternative pre heating solution and could use this to inform any future investment decisions.

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

NGN are committed to investing in new technologies that can contribute to more efficient ways of operating. If successful this project could lead to advances in pre heating technology, where reduction in maintenance costs, construction costs and potentially carbon emissions.

- Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

### 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.

n/a

### 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

n/a

### Relevant Foreground IPR

n/a

## Data Access Details

n/a

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

n/a

**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**

n/a

**This project has been approved by a senior member of staff**

Yes