

## NIA Project Registration and PEA Document

### Date of Submission

Oct 2018

### Project Reference Number

NIA\_NGGT0135

## Project Registration

### Project Title

Techno-Economic Feasibility of Solid State CO<sub>2</sub> Capture

### Project Reference Number

NIA\_NGGT0135

### Project Licensee(s)

National Gas Transmission PLC

### Project Start

October 2018

### Project Duration

0 years and 3 months

### Nominated Project Contact(s)

Andrea Hamilton, Sarah Matragrano

### Project Budget

£43,540.00

## Summary

The object of this project is to carry out a techno-economic (TEA) and life cycle analysis (LCA) of the CO<sub>2</sub>LOC process developed by Cambridge Carbon Capture (CCC) and compare it to other carbon capture utilisation and storage (CCUS) technology options for dealing with National Grid's gas compressor and pre-heat plant CO<sub>2</sub> emissions.

### Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

## Problem Being Solved

National Grid (NG) has made a firm commitment to reduce its carbon footprint by 80% by 2050 in accord with the Paris Agreement of 2008. A major source of carbon emissions for National Grid Gas Transmission are the gas fueled compressor fleet. A number of airborne carbon capture techniques are being proposed and developed. One such technology is that of Cambridge Carbon Capture who is proposing an inert solid CO<sub>2</sub> capture, in the form of a carbonate, process. To fully evaluate this technology, this project will conduct a techno-economic assessment (TEA) and life cycle analysis (LCA) of the CO<sub>2</sub>LOC solid CO<sub>2</sub> capture process and compare it to other carbon capture utilisation and storage (CCUS) technologies. The CCC technology has considerable potential for reducing CO<sub>2</sub> emissions from NG's compressor fleet and if the TEA and LCA provide sufficient evidence as to the potential of CO<sub>2</sub>LOC, will lead to a demonstration phase being considered.

## Method(s)

The project will be broken down into 5 key work packages (WP's) which are as follows:

WP1: Assessment of National Grid's Gas compressor fleet – review of locations and emissions, review of standard site designs, identification of duty cycles and operation strategies and selection of a typical site for detailed techno-economic and life cycle analysis. Milestones – Example site specification established. Deliverable – Compressor Fleet Suitability Matrix.

WP2: Techno-economic and life cycle analysis of CO<sub>2</sub>LOC technology at the selected site – Development of a model of CO<sub>2</sub>LOC plant at a selected site, establish estimates of likely OPEX and CAPEX highlighting assumptions, development of site operational logistics model, conduct TEA and LCA. Milestones – TEA and LCA available. Deliverable – TEA and LCA and supporting Excel

models.  
WP3: Scalability – Development of a model for CO2LOC deployment across the NG Network. Milestone and Deliverable – Assessment report of CO2LOC potential impact on NG emissions.  
WP4: Review of UK Emissions Landscape – Review of latest strategy documents on future UK emissions policy.  
WP5: Review of available CCUS technology options – Overview of technology approaches for CCUS for applications with distributed sources of emissions such as National Grid’s gas compressor fleet, TRLs, advantages and disadvantages in comparison with CO2LOC technology.  
The project will conclude with a final report highlighting key findings and recommendations.

## Scope

As previously mentioned, National Grid (NG) has made a firm commitment to reduce its carbon footprint by 80% by 2050 in accord with the Paris Agreement of 2008.

To achieve this target NG must investigate the technologies that are currently available and look how to potentially implement them on to NG’s plant, such as the compressor stations that are strategically placed around the country, with the main aim of significantly reducing their CO2 operational emissions.

There are currently proven technologies out there such as Carbon Capture and Sequestration (CCS) which is the process of capturing waste carbon dioxide from large point sources, such as fossil fuel power plants, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation.

Due to the remote location of some of these compressor stations and lack of available underground geological formations, CCS would not be physically or financially viable.

Cambridge Carbon Capture’s CO2LOC technology has the potential to capture some of NG’s operational CO2 emissions via a retrofit solution capable of storing the CO2 as an inert solid-state carbonate. This carbonate could also potentially offer some economic value.

This feasibility study is a pre-cursor towards a more in-depth piece of work to consider the viability of this process on NG plant.

## Objective(s)

The purpose of this study is to assess the benefits of the CO2LOC process, as well comparing it to other viable CCUS options.

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

n/a

## Success Criteria

To be successful the project will aim to form a comprehensive feasibility study that will deliver the following outputs:

- A map of National Grid’s compressor fleet emissions.
- Techno-economic analysis (TEA) and life cycle analysis (LCA) for a typical CO2LOC installation.
- Outline model of CO2LOC rollout across National Grid’s compressor fleet.
- Comparison of CO2LOC process with alternative technologies.

## Project Partners and External Funding

External Funding – Nil.

## Potential for New Learning

The potential for learning from this programme is to demonstrate if the CO2LOC technology, as well as comparing it against other CCUS technology, is capable of selectively removing CO2 from National Grid’s operational emissions from the gas compressors. This could potentially present National Grid with a viable and effective way to reduce GHG emissions.

## Scale of Project

Desk based.

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL3 Proof of Concept

## Geographical Area

N/A

## **Revenue Allowed for the RIIO Settlement**

None.

## **Indicative Total NIA Project Expenditure**

£43,540

## 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)

The purpose of this programme is to carry out a feasibility study so currently the financial savings would be unknown. If this programme is successful, the main saving would be the significant reduction in CO<sub>2</sub> that is released into the atmosphere from operational plant emissions.

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

N/A as this is a research project.

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

If deemed viable, this technology could in theory be rolled out to all 26 of National Grids compressor stations as well as any above ground installation (AGI) that contains pre-heat capability.

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

At present these costs are unknown.

### 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 learning from this feasibility study could offer a viable technological solution to help capture CO2 from exhaust gases. All Network Licensees could potentially benefit from this technology and apply it to their plant on varying scales.

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

This programme addresses the environmental sustainability aspect of National Grids innovation strategy by attempting to facilitate the transition to a decarbonised energy system by reducing National Grids carbon footprint.

- 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.

This project investigates the feasibility of this type of carbon capture technology being used in a gas transmission system. This technology has not been utilised on any gas transmission or distribution systems to date.

### 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 kind of carbon capture utilisation and storage has not been assessed for viability on a gas transmission system before. This project will conduct the necessary studies to determine if this solution is applicable to the National Transmission System and to evaluate the necessary development required.

### 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

There is no evidence that this technology would currently be in a suitable position to deploy on a National Grid site(s). Prior to any kind of rollout, this innovative feasibility study will provide the foundation on which to make an informed business decision.

**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**

The commercial and regulatory risks of not carrying out the feasibility study into the application of this technology are that the government may change their stance on current legislation and impose stricter CO2 targets that National Grid may not be in a position to react quick enough to. The environmental risks are that National Grid continue to contribute to the accumulation of greenhouse gases (GHGs) via operational emissions, subsequently speeding up global warming. These and the potential regulatory challenges that could be imposed, make it essential that National Grid undertake work to provide viable GHG minimising technologies. CO2 to mineralisation offers considerable benefits but the technical (reactor and material handling logistics) and operational (matching utilisation to emission profile) challenges make the NIA funding route appropriate. The NIA criteria allows for transparency and the sharing of knowledge. This feasibility study is a step towards helping to address a common goal amongst all network licensees which is to reduce our carbon footprint by 80% by 2050 under 2008 Climate Change Act. The knowledge shared via this NIA project could be beneficial to many different stakeholders.

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

Yes