Electricity/Gas Network Innovation Competition Screening Submission Pro forma

Notes on completion		
Before completing this form, please refer to the relevant Network Innovation Competition (NIC) Governance Document(s).[1] 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. Ofgem will publish all the information contained within this Screening Submission.		
Is the application for the Gas or Electricity NIC?	Gas NIC ☒	Electricity NIC ☐
Cross Industry Project	YES ☐ *If yes, please fill out Cross Industry Projects section*	NO ☒
Funding Licensee(s)		
National Grid Gas Transmission		
Network Licensee Project Partners		
Premtech Ltd, Cambridge Carbon Capture Ltd, Cullum Detuners Ltd		
Funding Licensee area(s)		
National Grid Gas Transmission		
Project Title		
Captivate – Large-Scale Demonstrator		
Project Summary		
National Grid Gas Transmission (NGGT) owns and operates large scale plant at compressor sites which produce operational CO2 emissions which can be detrimental to the environment. This pioneering innovation project aims to tackle CO2 emissions through a mineralisation process which, in addition to capturing these emissions, produces several by-products such as construction aggregate with a potential commercial value. Working with three SME's this project will produce a large-scale carbon mineralisation plant on a selected NGGT compressor site. The exhaust gas from the compressor will be reacted with magnesium hydroxide in the form of brine mud (a waste product from the production of plastics) to produce magnesium carbonate (a rock-like product), permanently storing the sequestered carbon in solid form. All technical challenges will be tackled in the scale-up of the technology, building on the work of the Captivate NIA Proof of Concept project and other parallel work outside of NIA and NIC developing the supporting supply chain. The project will produce a modular solution for rollout across NGGT's compressor fleet, whilst identifying opportunities for using the modular solution for CO2 capture on smaller scale gas distribution assets as well as large industrial users.		
Estimated Start Date	**Estimated End Date**	
April 2020	June 2023	
Estimated Project funding		

[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.

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.

Total Cost of Project **(If Cross Industry Project provide cost split in Cross Industry section)**	£11.7m	**NIC funding requested**	£10.53
Is the Technology Readiness Level (TRL) of the Project at start date between 4 and 8?	YES ☒	NO ☐	

What is the Problem?

The Licensee must provide a narrative that explains the Problem(s) that the Project is seeking to address.

CO2 is a greenhouse gas, the release of which is widely considered to be the leading cause of global temperature increase more commonly known as global warming. At current rates of emission, models by the Intergovernmental Panel on Climate Change (IPCC) suggest that an average global temperature increase of between 1.1 and 5.4°C is likely by the year 2100. This will have a huge impact on the global ecosystem. The UK Government's Carbon Plan (2011) sets the framework for how the UK aims to make the transition towards a low carbon future. The Climate Change Act (2008) established targets for the reduction in CO2 emissions of 80% below 1990 levels by 2050. To achieve this target, the act set out a system of 'carbon budgets' which provide limits on CO2 emissions. These target a decrease in emissions of 35% below 1990 levels by 2022 and 50% by 2027. NGGT is dedicated to being environmentally responsible and has made a commitment to reduce emissions of greenhouse gases, a key source of these is from large-scale combustion assets. This innovative project will enable the capture of CO2 emissions from a NGGT compressor unit as well as a modular solution to capture CO2 emissions from smaller scale gas distribution assets as well as large industrial users; therefore reducing the environmental impact of the gas network to UK Consumer as well as further improving the green credentials of natural gas.

Conventionally, to prevent the release of large quantities of CO2 into the atmosphere a Carbon Capture and Storage (CCS) process is used to capture CO2 with absorption technologies, after which it is compressed and then stored in large geological formations. Large-scale pipeline and storage infrastructure is also required to implement CCS at a meaningful scale. The energy required, cost to implement and the ongoing liabilities of the long-term storage of CO2 has so far prohibited large scale deployment. An alternative to storage of CO2 is conversion to commercially useful products such as construction materials where the CO2 is permanently sequestered. Additional CO2 emissions are also avoided by the replacement of carbon intensive construction materials. There are technical and commercial challenges to overcome, but the basic premise at laboratory scale is proven. The challenge to enable this for NGGT assets is to scale up this technology and develop the logistical and commercial model to make it a success.

What Method(s) will be used?

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 eg technical, commercial etc.

The method of CO2 removal and sequestration being demonstrated in this project is a novel emission scrubbing process. The mineralisation process does this by reacting the emission gases with magnesium hydroxide carried in an aqueous slurry to form a stable magnesium carbonate compound by-product. This by-product can then be processed to produce valuable construction materials, with initial lab trials showing this process to be very effective.

This 'Captivate Large-Scale Demonstrator' NIC project will build on the learning from the 'Captivate Proof of Concept' NIA to develop a large-scale process, overcoming the technological and commercial challenges and risks faced in order to capture these emissions at the scale and size required for NGGT's compressor units. This project will assess the viability of using brine mud, a waste product from the production of plastics, as a source of magnesium hydroxide for use in the process. The logistics of supplying the magnesium hydroxide to the site and how the resulting magnesium carbonate by-product is stored and removed from site will be assessed.

In addition, the data gathered in the project will be used to carry out a techno-economic analysis of the process and the validation of the business model. This will be used to assess the commercial viability for the supply of magnesium hydroxide and distribution of the subsequent by-products of the process throughout the project.

Method(s) continued

The project comprises of four stages:

--- Stage 1 - Project Establishment ---

- Finalise the process design and site selection activities through the Front-End Engineering Design (FEED) study. Activities to run in parallel include the development of the mineralisation process technology into a large-scale process design. This stage will include a global technology watch and best available techniques (BAT) assessment of potential existing technology for key components, plus cost benefit analysis against current mineralisation processes.

- Initial designing, building and testing of the key components for the high throughput CO2 reactor prototype required for the scale-up of the 'Captivate Proof of Concept' NIA project.

- Validation of the process design, confirming scale and final site selection as well as identification and specification of the required components and commencement of procurement process.

--- Stage 2 – Design and Build ---

- Multi-discipline detailed design for the process using Design for Manufacture and Assembly (DfMA) techniques. The design process needs to follow NGGT processes for new equipment and integration into site-based control systems, Formal Process Safety Assessments (FPSAs), planning, environmental studies and other regulatory compliance requirements.

- Final procurement of required components and off-site fabrication and testing.

- Civil works, on-site fabrication, build and site installation of the large-scale demonstrator. Works will be carried out in line with the relevant construction legislation and procedures including the Health and Safety at Work Act and NGGT procedures.

--- Stage 3 - Commissioning and Testing of Demonstrator Unit ---

Integration of the demonstrator unit into control systems, debugging, compliance checks and final sign offs, insurance and warranties.

Once the plant is running there will be a significant testing period of the demonstrator by a multi-discipline team of engineers who will develop and refine the process and validate the suitability of the by-product. In parallel the proposed logistical set-up developed throughout Stage 1 and 2 will be validated.

Stage 3 will deliver a carbon mineralisation plant installed on one compressor unit with the capability to capture a proportion of the compressor unit's CO2 emissions and produce a significant tonnage of by-product from the process.

--- Stage 4 - Business Readiness ---

All the data will be collected from the demonstration project and used to produce a modular solution for rollout across NGGT's compressor fleet and options for subsequent rollout across other emission sources on the gas network.

Ongoing works outside Captivate NIA and NIC projects are planned to demonstrate a future market/supply of materials and will be fed into the techno-economic analysis throughout this project. This will provide a set of commercial options for the roll out of the technology and will set out any further developments required as part of the supply chain.

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 RIIO-Network Licensees should indicate potential bid costs expenses

An approximate cost schedule has been developed and is estimated +/- 20%. Prices will be fixed in the final submission.

Stage 1 Project Establishment £2.53m (April 2020 - December 2020)

Stage 2 Design and Build £7.85m (November 2020 – July 2022)

Stage 3 Commissioning and Testing of Demonstrator Unit £1.11m (June 2022 - June 2023)

Stage 4 Business Readiness £0.22m (May 2023 - June 2023)

As well as the four main stages above, an ongoing techno-economic analysis will be carried out in parallel to update and refine the process, this is included in the above costs throughout each of the four stages. The techno-economic analysis will help to develop and consolidate the commercial routes for the potential roll out of the technology across the NTS.

The project will be developing relationships with upstream partners to develop the supply chain for the provision of magnesium hydroxide and will also be working with potential downstream partners to develop the market for the magnesium carbonate by-product of the CO2 capture process. This mineralisation technology provides upstream partners with a potentially large and profitable market opportunity, and downstream partners with potentially low cost and low carbon construction materials.

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)	☐	☒
A specific novel arrangement or application of existing electricity/gas transmission and/or distribution equipment (including control and communications systems software)	☐	☐
A specific novel operational practice directly related to the operation of the electricity/gas transmission and/or distribution systems	☐	☐
A specific novel commercial arrangement	☐	☒

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.

Last year a total of 594K tonnes of CO2 were emitted from NGGT's compressor stations. Using the UK government's central case 'social cost of carbon' estimate, the environmental cost to society is approximately £76 per tonne of CO2. This equates to a societal impact of approximately £45.1m per year. Using these current figures this could amount to a societal cost of £902M over the next 20 years. The cost of emitted carbon is also likely to increase each year as the environmental impact of each tonne of carbon released increases and the closer the world gets to a 1.5 degrees Celsius warning threshold.

Emissions of CO2 to atmosphere from NGGT's large-scale combustion assets are covered by the EU Emissions Trading Scheme (ETS) which requires the purchasing of permits to emit CO2 to atmosphere. Any cost savings from reducing the amount of the emissions permits required by capturing CO2 would benefit gas consumers. The project will target a reduction in CO2 emissions via a potential cost neutral end-to-end process.

One of the key attributes of the mineralisation technology is that it produces a number of valuable by-products. Revenue from the sale of these by-products has the potential to offset the cost of CO2 capture, which could contribute to the cost of further rollout and ultimately could deliver cost savings to the gas consumer.

This project has the potential to significantly reduce the emissions of CO2 from the exhaust gases emitted from gas turbine driven compressor units that are on the gas transmission network. This project will be the first ever large-scale demonstration of this mineralisation technology on a UK gas network and will significantly accelerate the development and subsequent roll out of the technology across the gas networks and potentially wider industry. Therefore, delivering significant CO2 emissions savings to the UK energy sector.

How will the Project deliver value for money for electricity and/or gas customers?

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.

This project will demonstrate large scale CO2 capture using a carbon mineralisation technology. The project brings together key engineering partners across the gas industry to develop, test and trial this pioneering technology. The knowledge and learning gained from this project will be of direct benefit to the future roll-out of the technology across the gas transmission and distribution networks where applicable.

Rather than simply storing the CO2, the magnesium carbonate by-product could potentially be used in the construction industry, ranging from direct replacement for gypsum in building products such as plasterboard and building blocks to fillers in ready mix cement. This could therefore reduce the demand on mining activities, hence supporting further environmental carbon benefits.

This project will develop novel commercial arrangements and a business techno-economic model to validate these economic estimates and demonstrate the commercial viability of rolling out this technology across the gas networks and beyond.

How will the Project generate knowledge that can be shared amongst all relevant Network Licensees?

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.

There are 5 main areas of learning that will be delivered by this project:

1) The process to design, develop and install the technology on a NGGT compressor site to capture CO2 emissions using the carbon mineralisation process.

2) Development of the upstream supply chain within the mining and chemical industry to supply large quantities of magnesium hydroxide onto the compressor site for processing.

3) Assessment of the viability to use brine mud as a source of magnesium hydroxide for the mineralisation process.

4) Development of the downstream supply chain, validating the use of the magnesium carbonate by-product and developing the relevant logistics to transport the by-product off site.

5) Techno-economic analysis and life cycle analysis of the process and a model that can be used to assess the commercial viability of the carbon mineralisation technology across the gas transmission network.

The project manager will prepare update reports identifying all relevant knowledge gained to the project steering committee at least twice a year. These will be published on the project web portal, details of which will be sent to all GB network licensees. Project progress will be reported through various media including video and interactive web-based engagement. Results and project learning will also be reported at conferences such as the Annual Innovation Conference at LCNI or Utility Week Live, in NGGT's Annual Network Innovation report and on NGGT's website: www.nationalgrid.com/gasinnovation

Does the Project conform to the default Intellectual Property Rights (IPR) arrangements set out in the NIC Governance Document?	YES ☒	NO ☐

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.

Click or tap here to enter text.

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?

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.

This project will follow on from the Captivate Proof of Concept NIA project, building on the knowledge and learning to develop a large-scale carbon mineralisation process, overcoming the technological and commercial challenges and risks faced in order to capture these CO2 emissions at the scale and size required for NGGT's compressors.

The innovative approach in this project is to capture the CO2 from the emission source, mineralise it and turn it into a useful product which is a completely novel approach to CO2 sequestration. The project will be the first of its kind in the UK. Without this crucial demonstration step it will be many years before this mineralisation technology will be available to the gas networks.

To demonstrate that the mineralisation process is effective, a large-scale trial is required to complete the build and commission of the demonstrator plant and provide data to support the modelling of the technology at full-scale across the network. This project will also facilitate work to bring together partners to develop the end-to-end supply chain needed to support the carbon mineralisation rollout across the network by ensuring the product has a use in the construction industry and that there are sufficient quantities of magnesium hydroxide available.

How were project Partners, external resourcing/funding identified, and what are their respective roles in the Project?

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.

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.

As a result of the Energy Networks Association's (ENA) joint call for NIC ideas on behalf of the gas and electricity networks, as well as NGGT's own call for ideas, a number of proposals were received. These were compared and assessed against the NIC criteria and NGGT's innovation strategy. The idea for Captivate was identified as the strongest candidate and so the process to develop the idea with Cambridge Carbon Capture Ltd began. Premtech Ltd and subsequently Cullum Detuners Ltd were brought in as project partners due to their specific expertise and previous experience required for the design, build and testing of this project. These partners are also involved in the Captivate NIA Proof of Concept. The required magnesium hydroxide input to the process as well as the magnesium carbonate by-product present an interesting opportunity for related industries who could be interested in partnering on this project.

At this stage the project has identified three partners to work with NGGT:

-- Cambridge Carbon Capture Ltd has extensive knowledge of the carbon capture technology and are developing a profitable CO2 and NOx capture and utilisation technology based upon IP-protected CO2LOC technology.
-- Premtech Ltd are a UK based SME providing engineering consultancy and design management to the UK gas industry. Premtech have a proven track record of successfully delivering designs, design management and innovation projects to NGGT and were instrumental in the success of the Project GRAID and CLoCC NIC projects.
-- Cullum Detuners Ltd, a UK based SME, provide engineering solutions to several industry sectors and have previously been involved in the design, fabrication and site-based construction and refurbishment projects of assets that currently exist on the NTS.

Will the Project require any derogations or exemptions?

The Licensee should outline if it considers that the Project will require any derogations, exemptions, or changes to the regulatory arrangements.

No derogations, exemptions or changes to regulatory requirements are required.

How will the Project activities impact customers?
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).
There is no planned direct interaction with customers' premises.
What funding is being requested from each NIC? (Cross Industry Projects only)
The Licensee must outline funding that is being requested from the Electricity and the Gas NICs and include a justification for the funding split.
N/A

Are there any further details the Licensee considers would support its submission?
Glossary of Acronyms used throughout document: NGGT -- National Grid Gas Transmission SME -- Small or medium sized enterprise CO2 -- Carbon dioxide IPCC -- Intergovernmental Panel on Climate Change CCS -- Carbon Capture and Storage FEED -- Front-End Engineering Design BAT -- Best Available Design DfMA -- Design for Manufacture and Assembly FPSA -- Formal Process Safety Assessments ETS -- Emissions Trading Scheme ENA -- Energy Network Association

Contact Information (*Cross Industry Projects can provide details for up to two contacts)*	
Contact Name(s)	
Tom Neal	Click or tap here to enter text.
Contact Address(es)	
National Grid House Warwick Technology Park Gallows Hill Warwick CV34 6DA	Click or tap here to enter text.
E-mail(s)	
tom.neal1@nationalgrid.com	Click or tap here to enter text.
Direct Telephone Line(s)	
+44 (0)7785 451353	Click or tap here to enter text.
Job Title(s)	
Innovation Delivery Manager	Click or tap here to enter text.