# SIF Alpha Project Registration

### Date of Submission

Nov 2022

### Project Reference Number

10036949

## Project Registration

### Project Title

HyNTS Compression

### Project Reference Number

10036949

### Project Licensee(s)

National Gas Transmission PLC

### Project Start

Aug 2022

### Project Duration

6 Months

### Nominated Project Contact(s)

box.gt.innovation@nationalgrid.com

### Project Budget

£559,035.00

### Funding Mechanism

SIF Alpha - Round 1

### SIF Funding

£499,898.00

### Strategy Theme

Whole energy systems

### Challenge Area

Whole system integration

### Project Summary

Hydrogen as an alternative to natural gas is key to ensuring that energy demands are met for heat, power, industry and transport in 2050. In order to transport & store hydrogen across the UK compression is required. This project evaluates the costs and opportunities to repurpose the existing National Transmission System (NTS) compression equipment minimising impact to gas consumers. Directly addressing the SIF challenge requirement of "evaluating the costs and opportunities of repurposing existing infrastructure or assets" and "co-ordinating approaches to sitting assets to deliver more efficient capital investment on the energy system".

The repurposing of NTS compressor systems for hydrogen has not been demonstrated, although desktop studies indicate its feasibility and cost effectiveness. The cost of a new compression system can be greater than £40m per unit and there are 70units on the NTS today. Discovery determined that Avon gas turbines could be enabled to be fuelled by 100% hydrogen and analysis of the compressor suggested that the compressor could operate with up to 50% hydrogen. However, for a blend of over 50% hydrogen, we will need to consider innovative solutions to modify or upgrade the compressor. The innovative solutions in development through this project to enable reuse of the compressors are vital to reducing the cost to the consumer of the energy transition.

Discovery found that future NTS scenarios are still in fluctuation and an important step to refine our strategy and business case is to undertake further network modelling utilising whole systems datasets. National Grid Electricity Transmission (NGET) will contribute

work undertaken on electricity demand and capacity alongside their work on potential locations of electrolysers in the UK which will feed into the modelling work to determine not only the level of compression required but where compressor stations will be required in the future. ITM Power will support with this task as an electrolyser manufacturer and green hydrogen producer.

Beta will look to demonstrate the potential for compression to meet the requirements determined through the whole system modelling with a minimal impact to the consumer. The compression loop will compress and transport hydrogen gas, to demonstrate the compatibility of typical NTS components. Engagement with the HSE through Discovery determined that application testing was required to provide safety and operational evidence for the repurposing of this system.

We have added two additional partners into the Alpha phase of the project, NGET and Cullum. As discussed NGET will support the modelling activities and ITM Power are also ideally placed to provide support with electrolyser requirements for the modelling work. Cullum join as our experts on compressor ancillary equipment and cab units to support Siemens Energy whom continue to deploy their knowledge and experience of the compressor systems. NGN and SGN will continue to support the project by contributing to the demand modelling, meetings and evidence gathering, as compression will impact the supply to the distribution networks in the future. DNV support the demonstration of the compression system and have extensive experience of gas pipelines, large scale testing and of the current compression systems.

The users of the project output will be the gas networks both in the UK and globally, providing alternative options to replacement of systems with hydrogen ready solutions that come at a premium. As the gas industry moves towards the use of hydrogen, there will likely be a requirement for hydrogen production facilities throughout the UK. The variability in production of green hydrogen will mean that compression is crucial to ensuring hydrogen can be moved through the pipeline system, dependent on demand, and is likely to be required on local transmission systems, not just the NTS.

## Project Description

The National Transmission System (NTS) is a network of high pressure natural gas pipelines, that supply gas to about forty power stations and large industrial users, from natural gas terminals situated on the coast, to gas distribution companies that supply commercial and domestic users. In order to move gas from producers to users, the system utilises several compressor systems located strategically across the country.

In order to achieve the UKs Net Zero targets by 2050, the gas networks will play an important part through the delivery of net zero gases such as hydrogen and biogas to users. These gases have different properties to natural gas and therefore need different control and management systems.

The HyNTS Compression project investigates the key challenges associated with compression of hydrogen and hydrogen blends through the NTS assets. The project aims to determine the technical and commercial feasibility, provide a technical demonstration and create a strategy for UK NTS Compression Systems. The project will determine whether the use of current compression assets on a hydrogen gas network is feasible, this in turn will help reduce the cost of the energy transition by eliminating the need to replace the compression systems. The largest costs in the current assumptions for migrating the NTS to hydrogen, is the cost to replace the compression systems, if this project determines that the current systems are unable to function with hydrogen, alternative cost-efficient options will be assessed and demonstrated.

The project will utilise demand predictions for hydrogen across the NTS along with modelling undertaken by the internal National Grid team and as part of Hydrogen Grid Research & Development (HGR&D) to determine the likely compression requirements. The Alpha phase project introduces further partners to support the future compression scenario development ensuring a whole systems approach. This will be the basis for the compression strategy, Cost Benefit Analysis (CBA) and environmental assessment.

The technical demonstration is planned to be conducted at the FutureGrid site in Spadeadam, Cumbria and will provide a facility for any future work as an outcome of this project, whilst enabling the facility to demonstrate further capability such as In-Line Inspection techniques and alternative metering systems.

## Preceding Projects

10023632 - HyNTS Compression

## Third Party Collaborators

DNV

Siemens Energy Industrial Turbomachinery Ltd

Cullum Detuners Limited

## Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

# Project Approaches And Desired Outcomes

## Innovation Justification

Use of hydrogen as an alternative to natural gas is essential for decarbonisation of the UKs energy network. The National Transmission System (NTS) will ensure hydrogen can be supplied to consumers reliably from producers. Compression is required to move gas from the producer to the consumer, build the linepack to store gas and direct flows within the network. The NTS currently pressurises gas up to 70-90 bar but it is thought this may need to increase with hydrogen due to the lower energy content. Hydrogen has different properties to natural gas and the same pressure ratio, which is currently achieved with methane, cannot be achieved with hydrogen without modification to the systems.

From the initial work undertaken it is thought that existing Avon gas turbines can be modified to be fuelled with 100% hydrogen, eliminating carbon dioxide and monoxide emissions. It is known that due to the high flame temperature of hydrogen, that nitrogen oxide emissions will increase and the potential to reduce, remove or capture these emissions will be considered in the Alpha phase of the project.

The initial analysis undertaken on the existing compressor unit suggests that the compressor may be able to compress blends of up to 50% hydrogen, if a drop in the pressure ratio achieved can be accepted. Beyond this 50% blend, modifications to the system in terms of more stages of compression would be required. This will increase the footprint of the compression system on site. The Alpha phase will have consider whether it would be more cost effective to modify the compressor, or replace with a hydrogen ready compressor for 100% hydrogen.

The next step was to consider the compression opportunity with various hydrogen blends. To achieve compression of varying hydrogen blends the compressor is required to rotate at varying speeds. An analysis was carried out on 60%, 80% and 100% hydrogen to determine the speed of rotation required. The Alpha phase will investigate the implications of a varying hydrogen blends in more detail and the potential systems which could be utilised to sense the gas composition upstream of the compressor and feedback to the compressor and control the speed of rotation.

In Europe, compression testing has been undertaken at a blend of 10% hydrogen, however this has not looked at the possibility of repurposing existing equipment. Our challenge looks at both existing equipment and blends \\>10%. The production of hydrogen and injection into the NTS is likely to be inconsistent due to weather fluctuations and varying demand, therefore we will need to understand how the system can manage variable blends of hydrogen and methane. To enable the compressor to react to the gas blend as required, automated systems at compressor stations will be required to sense the gas composition at the inlet of the compressor and feedback to control the compressor operation.

Each compressor on the network would cost at least £40m to replace. The project will consider the opportunity to repurpose the current compression assets for use with hydrogen and the system modifications which would be required. Determining the most cost effective and efficient route to compress hydrogen is vital to keep costs at a minimum for the NTS transition, and therefore energy customers, through to 2050.

Until the evidence has been provided that the gas network can accept hydrogen, natural gas will continue to be the transported fuel within the network and so any research into hydrogen requires funding outside of business-as-usual routes. SIF offers a unique opportunity to understand the technical feasibility of repurposing NTS compression assets and help to determine the most cost-effective solution for compression of hydrogen.

## Benefits

The repurposing of the UK gas assets in the energy transition is a key step in ensuring value for our consumers, with residual value of the current system being £6.5b. Supporting the continued utilisation of this system, and maintaining the jobs associated, is clearly an approach worth reviewing.

Natural gas compressor stations currently installed on the National Transmission System (NTS) emit large volumes of greenhouse gases, through both combustion and venting of natural gas. From 2020 to 2021, compressor stations released approximately 165,000 kg of carbon dioxide and 2,240,000 kg of methane into the atmosphere. The development of hydrogen ready compression systems will eliminate carbon emissions whilst the deployment of NOx capture will eliminate emissions and provide a truly green system.

Direct project benefits:

Economic: Determining the most cost-effective method of hydrogen compression for the NTS, providing a reduction in consumer costs

through the transition and into Net Zero.
Whole System: Providing a strategy for compression and developing whole system knowledge which will allow compression to be implemented across gas networks and hydrogen production facilities, where required in the UK.
Governmental: Developing UK capability, skills and competencies for net zero solutions, providing significant opportunity for export
Governmental: UK technology solutions development increasing the value of UK industry, encouraging inward investment into the UK hydrogen economy
Other hydrogen enabling benefits:

Consumer: Utilising existing gas assets with hydrogen for the National Transmission System prevents the installation of new significant investment systems and time delays for net zero
Safety: Prevents having to transport hydrogen above ground, eliminating the likelihood of transportation accidents
Resilience: Enabling hydrogen to be distributed through the gas pipeline network will allow the market for industrial and residential products that run off hydrogen to be both feasible and enter the market at a competitive price because the cost of transition to blended gases running in the network will be minimised.
Environmental: The C02 saving is substantial if the hydrogen is produced by renewable energy (green hydrogen), further reducing the countries reliance on fossil fuels and pulling demand for more renewables.
Consumer: Upgrades to existing gas boilers possible, maintaining the market for use of gas networks and existing central heating systems - reducing costs for consumers
The Discovery phase of the project has found that it is feasible to repurpose an existing Avon Gas Turbine to enable the turbine to be fuelled with 100% hydrogen. Implementing hydrogen as a fuel gas for gas turbines on the NTS would eliminate the 165,000 kg of carbon dioxide emissions which are released at compressor stations annually. The transportation of a hydrogen gas blend vs. natural gas will reduce the 2,240,000 kg of methane which is released into the atmosphere annually.

The cost to repurpose an existing compressor unit has not yet been assessed, but the costs will be developed in the Alpha phase of the project to develop a more accurate cost benefit analysis. A methane compression unit costs approximately £40m - £50m to replace, whereas a typical compressor upgrade costs £25m - £30m.

The attached business case demonstrates an approximated difference in costs for three future scenarios (method 1-3) this shows a potential for £2billion of savings. As we do not have all the costs for a hydrogen ready compression system, or a repurposed system; even utilising the costs of a methane unit upgrade (baseline 3) vs. new methane unit (baseline 2) would result in a potential saving of £1.165billion. Please see accompanying cost benefit analysis. This provides ample reasoning to further investigate this opportunity and deliver consumer savings through the transition.

## Risks And Issues

Potential risks identified for the Alpha phase of the project include:

a delay in signing contracts - mitigation - contract drafts will be shared on project submission to begin the process of agreeing the final draft
suitable resources being unavailable for the project - mitigation - senior management buy into the project and clear structures provided by each project team, early engagement with each partner prior to project start to confirm status
the gas turbine may not be able to be fuelled with hydrogen during demonstration due to the large volume of hydrogen required to fuel the gas turbines - mitigation - early investigation into this topic in Alpha and alternative demonstration options to be considered
modifications required to compressor to enable compression of 100% hydrogen may not be cost effective - mitigation - Alpha phase determination of business case to avoid demonstration of an inviable option
Any new risks and issues will be identified at weekly project meetings and mitigation put in place. A risk and issues log will be maintained and discussed at each monthly meeting. The delay to signing of contracts will be mitigated by giving all suppliers sight of the contract before we receive an offer of funding. This was a lesson learned during the Discovery phase as the project experienced delays due to contracting. This will ensure we can begin the project on the required start date. We will ensure that suitable resources are available by sharing project knowledge across the team and that detailed project documentation is kept to enable the project to continue in the case that a resource becomes unavailable.

As part of the Alpha phase we will investigate the requirement for additional hydrogen storage to enable the gas turbines to be fuelled with hydrogen for a sufficient demonstration time. To determine the demonstration time required we will gather typical test plans for the drive system and compressor, and discuss requirements with Safety colleagues within National Grid Gas PLC (GT&M).

Initial investigation indicates that a new compressor component is required for the compression of 100% hydrogen. This is likely to be costly and require the compressor to take up a much larger footprint. We have already engaged with compressor OEM's to review the compression technology available. During the Alpha phase we will develop costs for alternatives to repurposing to ensure that the most cost-effective solution is used in the demonstration.

Risks and issues will be logged and stored on the project sharepoint which all project partners will have access to. Each project partner will communicate any risks and issues to stakeholders within their organisations. The GT&M innovation lead will discuss risks and issues with the Innovate Monitoring Officer at regular intervals.

For SIF projects, each Project Partner shall own all Foreground IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation. The exact allocation of Foreground IPR ownership will determined during the contractual negotiations with the Project Partners on the agreement for the project.

Once the Project is completed, Relevant Background IPR will be licensed for use by the Project Partners in connection with another Project Partners' Foreground IPR solely to the extent necessary to use that Foreground IPR, upon terms to be agreed.

We intend to ensure each Project Partner will comply with Chapter 9 SIF Governance Document through the contractual terms governing the project. However, precisely how this is done will be subject to contractual negotiations with the Project Partners on the agreement for the project.

# Project Plans And Milestones

## Project Plans And Milestones

The Alpha phase of the project is split into five work packages:

WP1 Project management led by National Grid Gas PLC (GT&M) with support from the other project partners. The project will be managed through close monitoring of the project plan and early identification of risks to the programme. Weekly project meetings, monthly steering reviews and monitoring officer assessments will be undertaken to ensure the project is running to time and cost.
WP2 Business case and requirements led by GT&M and will include modelling, cost benefit analysis and determining the functional requirements of the project. The Alpha phase of the project will focus on further developing the requirements for compression on the future Net Zero network. To enable us to develop the future hydrogen network model, National Grid Electricity Transmission (NGET) will join the project team contributing learning from projects considering the future energy system as a whole, and the locations of future green hydrogen production facilities in the UK. ITM Power, SGN and NGN will support this work package.
WP3 Gas turbine Drive Systems and alternative drive systems led by Siemens Energy. This work package will investigate the use of hydrogen as a fuel gas for gas turbines, the capabilities of gas turbines currently installed on the NTS and potential impacts of hydrogen and hydrogen blends have to be investigated. The Alpha phase of the project will focus on the design of the drive system modifications required, the requirements of the fuel gas system and environmental impacts of using hydrogen as a fuel gas. This will also consider emissions abatement systems to reduce NOx.
WP4 Compressor equipment led by Siemens Energy. This work package will review the current compression systems installed on the NTS and investigate their capability to compress hydrogen. The impact of varying blends will be considered. The Alpha phase will focus on the design of the compressor modifications required for demonstration and determine the capability of the proposed repurposed compressor. The potential for variable gas blends to be compressed and the modifications which would be required will be further developed.
WP5 Site infrastructure and equipment led by DNV and supported by GT&M and Cullum will focus on the design of the test facility and required compression system ancillary equipment. To enable the design of a hydrogen ready compressor cab, Cullum have joined the project team. Siemens will support with the design to ensure that all aspects of the design are compatible. DNV will be the Principal Designer of the demonstration site. A HAZID (hazard identification) workshop will be conducted with all designers based on the conceptual designs submitted.
The success criteria of the project is based on the following milestones being delivered within the timescales and budget shown in the project plan appendix:

1. Reporting on visual inspection of existing compression equipment
2. Completion of NTS Compression modelling
3. Conceptual Designs
4. Final Reporting

The inclusion of the additional project partners alongside the Discovery team will enable the delivery of the project. The project in the Alpha phase will be predominately desktop based, determining the detailed design and business case for the Beta application testing. Project timelines and costs will be managed through robust management of the project plan and monthly project reviews covering timelines, costs and risks. Our approach to the financial management will be through delivery of the milestones proposed in the project plan.

## Regulatory Barriers (Not scored)

There are no regulatory barriers that prevent the delivery of the project through Alpha or Beta. These phases will enable the delivery of knowledge and systems for future application on our hydrogen investment activities such as Project Union. Uncertainty in the RIIO-2 funding mechanisms requirements and timelines could lead to projects not progressing in the assumed funding route or timescales proposed, however, discussions are ongoing to ensure we are approaching the activities in the correct manner with Ofgem and BEIS to reduce this risk.

Our network supplies natural gas to industrial, power and heat applications today and has a fantastic opportunity to support transport applications with net zero gases. The National Transmissions Systems (NTS) first application of hydrogen in the UK will be through Project Union, repurposing 2400km of pipeline to enable interconnectivity between the industrial clusters and strategic UK locations such as St Fergus and Bacton. Through this work we have commissioned a project with Frontier Economics to consider the options for regulation of 100% hydrogen networks.

There are several policy and regulatory systems in review around the introduction of hydrogen considering both 100% hydrogen and blended hydrogen. Primary and secondary legislation will need to be updated to enable blends of hydrogen within the network and

allow for the development of a 100% hydrogen NTS. Alongside this, rules will need to be agreed, such as the uniform network code (UNC) and Gas Safety Management Regulation (GSMR) to incorporate hydrogen blending and if required adapted for hydrogen transportation.

Engagement with our stakeholders and customers in the deployment of hydrogen and the timelines associated is vital to the success of future hydrogen deployment to ensure Network exit and entry agreements (NEXA/NEA) are aligned to the network approach in the vicinity of these customers. We have already begun these discussions with the majority of our key stakeholders through Project Union, these interactions have been very positive with an agreement that a hydrogen backbone in the UK is a requirement.

The policy landscape is already beginning to enable the deployment of hydrogen and through the continuation of the policies on hydrogen in industry, transport and power we will be enabled to deploy the findings of the SIF projects. The announcement of the industrial cluster decarbonization plans has been key to our hydrogen backbone proposal and with further progress of the later track clusters and introduction of further clusters we can support further decarbonization in the UK. Business model and regulatory regimes alongside these policies will ensure the robust and accelerated transition of the hydrogen infrastructure in the UK.

Consideration of interconnectors with Europe and their route to hydrogen deployment in their systems has already begun with the European hydrogen backbone proposal incorporating the NTS. Europe have accelerated their transition to having a blend of hydrogen in the network to 5% by 2024, in order to maintain interconnection with our counterparts we must be enabled to blend gas into our gas networks, protecting customers that cannot accept this with deblending technologies.

We continue to support Government and Ofgem in gathering the evidence required to deliver policy and regulation that will enable the energy transition through working groups such as Hydrogen Grid Research and Development (HGR&D) and Gas Goes Green (GGG). Evidence of our networks capability to support the transition is beginning the be reviewed by the HSE and development of approaches to blending both commercial and technical are underway through these collaborative working groups.

## Business As Usual

The project will develop the long-term strategy for hydrogen compression to ensure the energy transition is as cost effective as possible for consumers. The project is vital to keep costs to a minimum for the deployment of hydrogen in the gas networks.

The National Grid Gas PLC (GT&M) project team has expertise in asset management, rotating machinery and hydrogen innovation. This ensures that we have compression subject matter experts and the relevant asset management personnel involved to input to the direction and requirements for the project. Representatives from the Project Union team will also be involved in the project to ensure that the outputs can be implemented in the hydrogen backbone. The compression strategy created will inform asset strategy when making decisions for asset replacement at each compressor station, to ensure that systems can be hydrogen ready where possible.

The hydrogen team at GT&M will be responsible for the implementation of the compression strategy. On completion of the project the results of this project will feed into Project Union; the ambitious national grid gas led project to provide a high pressure hydrogen backbone in the UK linked to Europe and the industrial clusters; with repurposing of assets due to begin 2025. This activity looks to support the first track industrial clusters in the UK, providing a resilience to hydrogen supply. It is vital that the learning from the compression project is utilised to provide links between the clusters and terminals to ensure that hydrogen can be transported to and from each industrial cluster. Following Project Union blends across the network are possible through to 2050 and the HyNTS Compression project enables the safe, efficient and cost effective movement of hydrogen from producer to user.

As the hydrogen economy grows, and there is more demand for hydrogen, additional compressor stations will require conversion and the strategy will inform the most cost effective way to do so. There may be a requirement for additional compressor stations to be built. The evidence gathered in this project will help to identify the best locations for these stations, and the most suitable hydrogen compression solution, dependent on requirements.

The learning gained during the project will allow existing compression systems to be upgraded to manage hydrogen and develop the most cost-effective solution for replacement when necessary throughout the UK. The learning could also support the development of hydrogen ready transmission compression assets across the globe and could be exploited as such.

The project will include regular stakeholder updates throughout, to ensure key UK projects are engaged and learning is shared. This will enable other gas networks, hydrogen production facilities and industrial consumers to implement compression of hydrogen in localised areas, if required. The project will include suppliers and experts in compression drive systems, compression, electrolysis, compression cabs and ancillary equipment and hydrogen gas seals. Many of these project partners are international companies operating worldwide. The knowledge gained by suppliers will enable them to provide hydrogen ready compression systems and associated equipment, and where possible, help to modify existing assets for use with hydrogen in the UK and internationally.

# Commercials

## Commercialisation

The driver behind this commercialisation strategy is the need to meet the UK's net zero emissions target by 2050. Following government direction, that the UK should develop 5GW of low carbon hydrogen production by 2030 (raised to 10GW by the revised British Energy Security Strategy in April 2022), Gas Networks need to develop a commercial approach to transport and transition from methane to hydrogen at best value to the consumer.

All gas turbine OEMs are currently developing the capability to operate their equipment on increasing levels of hydrogen. Positive competition is encouraged, as this brings the best solutions to the surface and in turn, benefits all involved, including the consumer. With respect to HyNTS, the gas turbine capability is a generic offering available to all customers of Siemens Energy. The materials are selected for the specific gas and the flow path is designed for the suction and discharge conditions. Since there are so many compressor manufacturers globally, there is already a well-developed competitive market. In the deployment of any repurposing activity competitive tenders will be undertaken as per regulatory requirements.

Working groups such as H2GAR and GERG encourage knowledge sharing with European and UK hydrogen projects this allows collaboration between different industrial partners and academia to bring the best and most innovative solutions (and to share best practises) to the end users/consumers. The ability to operate on hydrogen fuel will reduce the carbon footprint of the gas turbines consistent with global efforts to combat climate change.

The primary customer for the outcomes of this project are gas network operators utilising centrifugal compression, however, many other industries, such as oil and chemical industries, also utilise these systems and may benefit. All partners will gain a level of knowledge that could enable them to provide additional value to the UK through export. The solutions developed could be utilised globally providing an opportunity for the project partners. This project will further develop the UK knowledge base, which could in turn generate employment opportunities in furthering this innovation research and creating engineering expertise and skills.

Siemens will enable the ability to operate on hydrogen fuel to be offered to all current and future Siemens Energy aeroderivative gas turbine operators. Their compressor products are available to anyone across the globe in any market segment (given there are no legal imposed sanctions). After the Beta phase there is the opportunity for this learning to be implemented in many industries including oil, gas, chemical, mining, food, paper, steel and medical. SIF governance terms around commercialisation will be met through the negotiated contract terms.

The use of hydrogen fuel reduces carbon dioxide emissions and therefore reduces exposure to carbon emissions penalties and will prolong the viability of installed gas turbines. This extension in life of the existing assets means capital expenditure can be realised over a longer period, reducing the whole life cost of the operating assets to ensure consumer value.

A global leader in the energy sector, Siemens Energy offers the capability to use hydrogen fuel without external partnerships. Where the value proposition is favourable, partnerships will be considered. Siemens Energy compressor products have been commercialised since around 1868 with more than 12,000 products installed worldwide, thus they have an existing, successful route to market.

As the OEM of the equipment, Siemens Energy have no capital, but do have a large commitment to R&D within their business. These R&D budgets allow them to invest into our portfolio of products to constantly improve performance, reduce emissions and extend life. This allows the business to grow and to commercialise new R&D products.

## Intellectual Property Rights (Not scored)

For SIF projects, each Project Partner shall own all Foreground IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation. The exact allocation of Foreground IPR ownership will be determined during the contractual negotiations with the Project Partners on the agreement for the project.

Also if the party appoints a sub-contractor, the agreement with that sub-contractor should have similar IP provisions to those in this agreement and which at least achieve the same aims as the agreement regarding IP.

Once the Project is completed, Relevant Background IPR will be licensed for use by the Project Partners in connection with another Project Partners' Foreground IPR solely to the extent necessary to use that Foreground IPR, upon terms to be agreed.

Describe how each Project Partners complies with Chapter 9 SIF Governance Document.

We intend to ensure each Project Partner will comply with Chapter 9 SIF Governance Document through the contractual terms governing the project. However, precisely how this is done will be subject to contractual negotiations with the Project Partners on the

agreement for the project.

## Costs and Value for Money

The project will cost £559,035, which is split between the project partners based on the level of activity in the alpha phase of the project. The project partners are contributing a total of £59,137 to the project, and we are therefore requesting funding of £499,898.

Two additional project partners have joined the Alpha phase, including National Grid Electricity Transmission (NGET) and Cullums Detuners.

The costs are split as follows:

Gas Transmission and Metering: The costs include the project management of the project, modelling of future energy scenarios and technical input to the project from Gas Transmission and Metering from subject matter experts. Gas Transmission and Metering are contributing £50,000 to project costs.

National Grid ET: to provide input to modelling scenarios to help to determine the hydrogen compression requirements of the future. This support is critical to the project to ensure the project considers the full energy system, not just the National Transmission System.

DNV: These costs are vital to the project to develop a conceptual design of the demonstration site at FutureGrid. The costs include a topography drone survey and costs to create a detailed move plan for the compression system.

Siemens Energy: These costs are vital to the project as Siemens Energy are the original equipment manufacturer for the compression equipment to be assessed. The costs include a detailed assessment of the capability of the drive system and compressor to be utilised with hydrogen, and conceptual designs for a modified rotating machinery package and a new compressor capable of compressing 100% hydrogen. Siemens Energy are contributing £900 to project costs.

Cullum Detuners: These costs are critical to the project to assess the potential for mechanical ancillary equipment of the cab to be re-used or repurposed for use with hydrogen, and the subsequent conceptual design of the ancillary equipment. Cullum Detuners are contributing £7,637 to project costs.

ITM Power: These costs are critical to the project for the modelling of future energy scenarios. ITM Power will provide the likely future locations of green hydrogen production in the UK, and the likely outputs of electrolysers. This will help us determine whether compression could be managed at hydrogen production facilities or will be required elsewhere in the UK. ITM Power will be contributing £600 to the project.

NGN: which includes input to the modelling scenarios to determine hydrogen compression requirements. This support will enable to project to consider the local transmission system (LTS) and gas distribution networks in the full model and determine whether there will be a requirement for compression on the LTS in the future.

There are no other business-as-usual (BAU) financial mechanisms to cover these costs outside of further Network Innovation Allowance (NIA) process funding. A successful SIF application would free up funding under NIA to be refocused on other Net Zero and transitional network projects. BAU activities include a number of ongoing compressor station upgrades; this work would enable hydrogen to be considered in these upgrades and ensure equipment which can be repurposed for use with hydrogen, is kept for use during the energy transition. The research burden of the transition to hydrogen being funded by SIF will allow this value to be added to work programmes at no extra cost to regulated consumer funded investments.

## Supporting Documents

### Documents Uploaded Where Applicable

Yes

### Documents:

Alpha Skills and Expertise Combined.pdf

HyNTS Compression Alpha Application Project Plan Final.pdf

SIF Alpha Project Registration 2022-11-03 2_54

HyNTS Compression Alpha Report redacted.pdf

SIF HyNTS Compression Alpha Show and Tell.pdf

SIF Alpha Project Registration 2024-02-20 10_48

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

☑ Yes