national gas transmission

SIF Alpha Round 2 Project Registration

Date of Submission

Jan 2024

Project Reference Number

10079461

Initial Project Details

Project Title

HyNTS Waste Heat Recovery for Electrolysis

Project Contact

Matthew Hammond

Challenge Area

Preparing for a net zero power system

Strategy Theme

Net zero and the energy system transition

Lead Sector

Electricity Transmission

Project Start Date

01/10/2023

Project Duration (Months)

6

Lead Funding Licensee

NGT - National Gas Transmission PLC

Funding Licensee(s)

NGT - National Gas Transmission PLC

Funding Mechanism

SIF Alpha - Round 2

Collaborating Networks

SGN

Technology Areas

Hydrogen

Gas Transmission Networks

Project Summary

The Electrolyser Improvements driven by Waste Heat Recovery project looks to demonstrate efficiency improvements in hydrogen production through the use of waste heat produced in the transportation of network gases.

Add Preceding Project(s)

10052878 (1) - Electrolyser Improvements driven by Waste Heat Recovery

Add Third Party Collaborator(s)

Anglian Water

Alfa Laval Aalborg Oy

HydroGenus

Cardiff University

Project Budget

£429,703.00

SIF Funding

£386,732.00

Project Approaches and Desired Outcomes

Problem statement

How and why your perception of the problem has evolved

The National Transmission System (NTS) utilizes compression to increasepressures and flows in the pipelines to ensure gas demand can be met. The majority of compressors on the NTS are driven by gas turbines, which are fuelled by natural gas taken from the NTS. These assets produce emissions and waste heat which are currently lost to the atmosphere. National Gas Transmission (NGT) has a number of projects looking at fuelling gas turbines with hydrogen generated from electrolysers. This project will address both emissions and waste heat fromthe turbines, whilst utilizing the waste heat in an electrolyser to produce hydrogen. Emissions capture solutions will be implemented and waste heat will be captured as steam and fed into an electrolyser. The hydrogen produced will also be fed into the gas turbine to reduce carbon emissions. Additionally, the project will explore the opportunity of connecting local hydrogen users with green hydrogen.

How and why your Project has evolved

The Discovery phase determined that gas turbine utilization was a key factor insizing the electrolyser and waste heat system. Many of the compressor units onthe NTS run intermittently and have low running hours, meaning the steamproduction would be intermittent. The Solid Oxide Electrolyser can run "cold" (without steam input), however the steam increases the efficiency of the system. The Alpha phase will therefore determine criteria for the viable deployment ofwaste heat recovery on compressor stations. The business case will also be developed further in the Alpha phase.

How your Project meets, or continues to meet, the primary Innovation Challenge aim and theme area stated

This project looks to address the challenge of preparing for net zero power systems using novel ways to reliably support low stability systems. Green hydrogen production is a low stability system in that the production is reliant on the weather (wind/solar) and/or constraints in the electricity network. This makes it very hard to predict the alignment of production and use of hydrogen. Improvements in the efficiency of hydrogen production will maximise the hydrogen created within periods of high renewable energy availability. Solid oxide electrolysers have improved efficiency over conventional PEM/alkaline electrolysers, however they must operate at high temperatures to realise this efficiency increase. Utilizing waste heat which would otherwise be lost to atmosphere will enable more efficient green hydrogen production.

The potential users of your innovation and how your understanding of their needs has evolved

The focus of this work is on the gas transmission system but the solutions developed in this project could be utilised across the UK where waste heat isavailable to improve the efficiency of hydrogen production. Other industries which produce significant waste heat could also benefit from this work.

Other network innovation funded work have you already completed that is relevant or is contributing to this Project

NIA Hydrogen Fuel Gas for NTS Compressors -- this project looked at theopportunity for fuelling a gas turbine with hydrogen produced by electrolysis. The findings of this NIA project have been fed into the Waste Heat Recovery project to avoid duplication and repetition of work.

SIF HyNTS Compression Discovery and Alpha -- The SIF HyNTS Compressionproject is looking at the opportunity to repurpose a compressor unit for hydrogen, including the gas turbine, providing the technical and safety evidence for this. The outputs of HyNTS Compression will feed into the Waste Heat Recovery SIF project Beta phase.

NIA Hydrogen Production Technologies for the NTS -- this project investigated the opportunity of placing various hydrogen production technologies on NTS sites, including pyrolysis and electrolysis.

Innovation justification

How does your Project demonstrate novel and ambitious innovation in theenergy networks?

Challenge Theme
This project looks to address the challenge of preparing for net zero powersystems using novel ways to reliably support low stability systems. Green hydrogen production is a low stability system in that the production is dependent on the weather (wind/solar) and/or constraints in the electricity network. Thismakes it very hardto predict the alignment of production and use of hydrogen. Improvements in the efficiency of hydrogen production will maximise the hydrogen produced in periods of high renewable energy availability and reduce the overallcost of hydrogen.

Previous innovation projects
We have undertaken several innovation projects looking at the feasibility of deploying electrolysers and utilising hydrogen in gas turbines and other assets to reduce emissions before hydrogen is available in the NTS. Green hydrogen from electrolysis is the best approach for emissions reduction but can be costly, so hydrogen production efficiencies should be maximised.

Working with stakeholders and beyond incremental innovation
The project has engaged with National Gas Transmission internal teams including Subject Matter Experts in Rotating Machinery, Operations and Policy and Regulation to help define the system requirements, as well as other networks to understand their needs. The project has also engaged with other SIF projects to share knowledge and experience, including UKPN's 'Connectrolyser', WWU'sNextGen Electrolysis and NGT's Hybrid Storage System projects.

Project Innovative Aspects
The application of waste heat recovery on gas turbines is not new but the application for National Transmission System (NTS) assets has not previously been investigated. The integration of waste heat recovery with solid-oxideelectrolysers (SOE) has not previously been considered and could provide an optimised hydrogen source for many applications. SOE is a relatively new technology which is looking to demonstrate capability in 2023 alongside theDiscovery and Alpha phase of this project to enable full demonstration of the system in 2024.

State of the Art
PEM and alkaline electrolysers are currently more established technologies but less efficient than SOE, leading to less hydrogen produced for every unit of electricity utilised and increasing the overall cost of hydrogen. Waste heat recovery is not currently deployed on NTS assets and doing so could enable SOE for hydrogen production as well as other applications including hydrogen storageor electricity generation from steam turbines.

TRL, IRL and CRL
The integration of waste heat recovery with solid oxide electrolysers is a novelapplication;
TRL Discovery 2-3, Alpha 4-5 and Beta TRL 6-7
IRL Discovery 1-2, Alpha to 4-5, then up to 7 at the start of Beta
CRL Discovery 1-2, Alpha 4-5

Project Scale
The demonstration will take place on a low utilisation compressor station, reducing the CAPEX on equipment and minimising disruption, whilst allowing the increased efficiencies to be demonstrated on an active site. The project will consider different sites on the NTS to better understand the business case and wider roll out of the solution.

BAU
The proposed system is novel and low in TRL therefore it cannot be deployed as business-as-usual (BAU). The BAU alternative is limited by efficiency and therefore the business case is harder to justify. SIF funding will enable this technology to be accelerated into use across the 24 compressor stations. In the case that hydrogen does not become available in the NTS this solution will enable reduction in emissions whilst providing hydrogen for other users in the local area.

Counterfactuals
We have considered the deployment of PEM/alkaline electrolysers for onsite hydrogen production, however these solutions lack

an innovative aspect. The chosen approach will result in increased hydrogen production efficiency as well as capturing waste heat from gas turbines which is currently released to atmosphere.

Complementary SIF projects.pdf (opens in a new window)
(/application/10079461/form/question/33889/forminput/91706/file/564415/download)

Impact and benefits (not scored)

Financial - future reductions in the cost of operating the network

Financial - cost savings per annum on energy bills for consumers

Financial - cost savings per annum for users of network services

Environmental - carbon reduction – direct CO2 savings per annum

Environmental - carbon reduction – indirect CO2 savings per annum

Revenues - improved access to revenues for users of network services

Revenues - creation of new revenue streams

New to market – products

New to market – processes

New to market - services

Impacts and benefits description

Pre-innovation baseline
Compressors are critical assets on the National Transmission System (NTS), providing pressures and flows to meet demand for gas and provide flexibility on the network, in total 65 of 74 compressor units are driven by gas turbines, burning natural gas from the network, thereby emitting carbon dioxide. As this is the single largest source of emissions on the NTS, National Gas Transmission have an obligation to reduce these compressor emissions and are also required to meet the Medium Combustion Plant (MCP) directive by 2030.
Hydrogen is a potential solution which can be utilised as a fuel gas in most of the gas turbines to reduce emissions, however it is unlikely to be available in the majority of the NTS before 2030. An alternative is to produce hydrogen directly onsite from electrolysers, which can be done more efficiently in combination with waste heat recovery. The deployment of hydrogen as a fuel to our gas turbines by 2030 will enable them to be ready when hydrogen is transported in the network and prevents multiple investments into the assets.

Forecast benefits
The alpha phase will further develop the business case and the cost/benefitanalysis for this project. The benefits that we propose to track are as follows:

Financial - Electrolyser efficiency with waste heat recovery vs alternative commercially available system

From Discovery outputs, the efficiency of solid oxide electrolysers with waste heatrecovery is 40 kWh/kg hydrogen compared to "low temperature" PEM/Alkaline electrolysers at 54 kWh/kg. Therefore, less electricity is required to produce the same amount of hydrogen, leading to a lower levelised cost of hydrogen for solidoxide electrolysers with waste heat recovery. Over time, this would pay back the initial investment and provide lower cost hydrogen with no direct CO2 emissions.
Early calculations suggest initial savings of up to £36m could be achieved by utilising onsite electrolysis with waste heat recovery across the network whencompared with offsite electrolysis and H2 delivery by tube trailer. Furthermore, savings of up to £56m across the network over 20 years in general could berealised through the lower levelised cost of hydrogen.
More widely, there are currently 30 Avon gas turbines on the NTS which are earmarked for replacement in order to meet the MCP Directive as no alternative low emissions retrofit technology will be ready by 2030. If these units can be repurposed for hydrogen by 2030 (which would also necessitate adequate hydrogen storage and supply), National Gas could avoid replacing these units at

a cost of ~£60m each, or £1.8Bn in total.

Environmental - System Emissions
In 2021, Avon gas turbines at compressor stations emitted around 106,000t CO_2 from burning natural gas. If the fuel gas contained 20%vol hydrogen this would decrease emissions by ~7%, or alternatively could be eliminated if 100% hydrogen is used as the fuel gas. In the highest utilisation scenarios, using 100% green hydrogen could result in significant CO_2 emissions savings of up to 12,000t per year per compressor. Using green hydrogen from electrolysis would mean there would be no indirect CO_2 associated with the hydrogen production. Benefits could be seen during the beta phase, once the demonstration is operational, however most benefits will occur once the system has been deployed across multiple operational sites. We believe this could be through the ProjectUnion timeline of between 2026 and the early 2030s for the gas transmission network.

Benefit Synergies
A broader understanding of the wider system benefits will be achieved through working in conjunction with other SIF projects (HyNTS Hybrid Storage, Carnot
Gas Plant & Connectrolyser) to ensure alignment and that synergistic benefits arecaptured.

Teams and resources

Changes to project team
UK Power Networks are no longer a partner on the project. UKPN will remain a partner on NGT's Hybrid Storage project. In Alpha NGT will engage with the UKPN BAU team to discuss electrical connections for the electrolyser.

Ceres, who previously looked at the solid oxide electrolyser requirements and capability for hydrogen production, are no longer a partner on the project. We have changed the approach for Alpha as the electrolyser likely won't be funded through SIF. Instead the requirements for the electrolyser for the demonstration will be finalised and this will be used to go to tender for the solid oxide electrolyser in the Alpha phase.

Skills and Expertise

National Gas Transmission (NGT) are the lead participant in the project and will provide clear direction and insight to the project partners on the project application and proposed benefits. NGT will also provide insight into our Hydrogen strategy and the part the national transmission system must play in the Net Zero future. This is vital in the project team developing their implementation strategy and business case as the project progresses through the delivery phases.

Alfa Laval Aalborg Oy have decades of experience in engineering and supply of boiler systems such as combined heat and power, combined cycle and other type systems for power engines globally. They will support the project with process design, supply of equipment including installation and commissioning for heat recovery boilers and whole steam system components together with process heatexchangers.

Hydrogenus Ltd aims to become the leading UK developer for local production of low-carbon hydrogen by electrolysis, with extensive experience in the electricity, hydrogen and water industries, including financial, regulatory, technical, commercial, and operational assignments. All the team have experience in undertaking feasibility studies to inform and prepare for follow-on developmentprojects, some with mature technologies, and some within the innovation space.

Cardiff University's Gas Turbine Research Centre (GTRC) have collaborated on several related projects with NGT and partners, assessing the potential for the application of hydrogen in the compressor gas turbine fleet, and quantifying the prospective changes in harmful emissions production. The GTRC team will provide technical insight into the potential for integrated emissions reduction technology as well as peer reviewing the project approach. Cardiff will also utilise their data science expertise to build a model of the system and use data tooptimise the design.

Anglian Water Services designs, builds, owns and operates water and water recycling assets across the east of England.

Anglian Water have dedicated Innovation and Engineering teams familiar with delivery of similar projects utilising internal investment and delivery of projects utilising Ofwat Innovation Funding.

Alpheus is a leading water and wastewater asset management company specialising in large wastewater treatment plants. Alpheus manages some of the largest private and public UK sites across a wide range of sectors including pharmaceuticals, food and beverage, leisure, power, educational and researchcampuses. They also own and operate four licensed waste disposal centres forthe reception and treatment of tankered liquid waste.

SGN have extensive knowledge of the technical challenges associated with transitioning networks to Hydrogen. SGN are also committed to delivering value for money and exceptional customer service as well as providing a safe, secure and sustainable future for our network. They will provide complimentary input from the Carnot Gas Plant project which is looking at waste heat recovery for heat networks.

External Parties
There are industrial users based near the Duxford site who could use the hydrogen to decarbonise their processes. These parties will be engaged withthrough the Alpha phase via Hydrogenus who are developing the hydrogen hub.

Project Plans and Milestones

Project management and delivery

How will you manage your Project effectively?

The Alpha phase will be undertaken through 5 work packages, utilising agile project management methodologies to complete a detailed design by the end of the 6 month period. We will aim to run tasks in parallel and summarise in a concise report to conclude the detailed design phase. Requests for information (RFIs) & actions will be tracked utilising SharePoint space with partners to ensure timely/efficient sharing of information.

WP1 - Project Management led by NGT supported by SGN -£52,028.75

This work package will ensure the project meets its projected timing, risk and costthrough the Alpha period and will develop the plan for the Beta phase project.
Milestone1 -- Beta Application
SC1 - Final report completed and Beta application submitted
Milestone2 -- Peer Review
SC2 - Peer review report submitted

WP 2 - Business Case & Requirements Development led by NGT -£8,538.75

This work package will develop the key requirements for the system and developthe business case and robust CBA for the system to be deployed.
Milestone 3- Project Completion
SC3 - CBA updated ready for Beta application

WP3 - Waste Heat Recovery Led by Alpha Laval -£139,600.00

This work package develops the detailed design of the waste heat recovery onNTS compression systems and determines the costed development plan for Betaand use case development for NTS deployment.Milestone4 -- Site Surveys
SC 4 - Surveys of existing National Gas site to assess utility supplies and spaceand integration of proposed new equipment
Milestone 5 -- Mid-project milestone
SC 5 - Confirmation of GT performance, agreement on operation philosophy,HAZOP attendance, heat and mass balance diagram, pipework andinstrumentation diagram
Milestone 6 -- Project Completion
SC6 - Equipment specifications and selections, general arrangements, layoutdrawings, controls design, steam turbine interface, inspection and test plan, costand schedule for Beta.

WP4 - Solid Oxide Electrolyser System led by NGT supported byHydroGenus -£37,038.75

This work package develops the detailed design and integration system for theSOE with the proposed system and considering the LCOH for different systemconfigurations.
Milestone 7 - Mid-project milestone
SC7 - Scope of work complete and ready for engagement activities
Milestone 8 - Project completion
SC8 - Procurement process

WP5 - System demonstration led by NGT -£149,525.75

This work package determines site specifics and associated costs related toelectricity connection, water access & treatment, systems integration, planning &permitting, demonstration design, build & commissioning and the testing plan.
Milestone 9 -- Project Completion
SC9 - Design of demonstration including equipment layout and integration on site,permit requirements, Build and commissioning plan & Test plan development.
Milestone 10 -- Project Completion
SC10 - Commercial arrangements for system, electrical connection and hydrogenofftake
Milestone 11 -- Project Completion
SC11 - Sampling programme and discussions with Environment Agency regardingwater connection.

Milestone 12 -- System Optimisation
SC12 - System optimisation through data modelling and AI.
Risks will be managed as identified via the risk register with appropriate mitigation strategies applied throughout the alpha phase. Project meetings will recordprogress in line with the project plan and actions will be tracked to ensure timely decisions can be made. The key risk associated with the project is mitigating the impact of low GT utilisation at the Cambridge site to show a valid CBA and business case. By identifying the rollout and number of commercially viable siteson the network to deploy a waste heat recovery solution. Ongoing associated risks with project management and meeting SIF requirements will be manged by the project team through project setup and delivery. Contracting discussions will beinitiated as soon as confirmation of award is confirmed as lessons learnt from the Discovery phase.
Project Management Book - HyNTS Waste Heat Recovery for ElectrolysisFINAL.xlsx (opens in a new window) (/application/10079461/form/question/33893/forminput/91730/file/564897/download)

Key outputs and dissemination

What are the expected key outputs of your Project and your plan for disseminating them along with any lessons learned?

Objectives for Alpha and Responsible Partners
The key objectives of the Alpha phase is to produce detailed designs for the system components to enable the Beta demonstration and determine theapproach to implementation post demonstration.

Alfa Laval will produce a detailed design of the waste heat recovery system and steam turbine, and a construction plan and costs for the Beta phase. This includes site surveys and HAZID/HAZOP activities.
The requirements for the solid oxide electrolyser will be finalised based on the Discovery phase findings. This information will be used to go to tender for the electrolyser to determine a suitable supplier for the Beta demonstration. As the lead network and asset/site owner and operator, National Gas will deliver this alongside HydroGenus who are developing the wider hydrogen hub.

HydroGenus will be exploring the links to local hydrogen users and thecommercial opportunity in more detail, including the financing strategy andHydrogen Contracts for Difference application. Additionally HydroGenus will lookinto the electricity connection and procurement process for the electrolyser.

Anglian Water along with Alpheus Ltd as a subcontractor will deliver the designand engineering for the water supply connection, treatment and storage asrequired by the waste heat boiler. This includes sampling activities from the localwater course to determine the water quality and possible treatment requirements.

Cardiff University will continue their role as a peer reviewer but bring on addedcapability for Alpha to look at system optimisation through modelling andsimulations. They will build a model of the system and use data to optimise thedesign.

The Alpha phase should deliver a clear implementation plan to show the key steps and timelines for the demonstration. National Gas Transmission will be responsible for this output.

Whilst working directly with our project partners we will also be engaging:
- Suppliers of solid oxide electrolysers and associated systems
- Nuclear industry contacts whom are engaged in developing similar systems for'pink' hydrogen production
- Gas and electricity networks whom could also benefit from the project output
- UK gas turbine owners whom could use waste heat for electrolysis

Dissemination of Outputs
As part of the Alpha phase we will set up steering meetings where key outputs can be presented to internal NGT stakeholders as well as cross-project steering meetings which will involve sharing findings and progress with team members of SIF Hybrid Storage and UKPN's Connectrolyser project.
The key outputs will be compiled by NGT into a single project report which will be uploaded to the Smarter Networks Portal, along with other supporting documentation which has been approved for sharing outside of the project.
Furthermore, the findings from the project will be shared with NGT stakeholders through internal webinars and relevant meetings including Asset Management, Asset Strategy, Policy and Regulation, and Project Union.

Commercials

Intellectual property rights, procurement and contracting (not scored)

What are the Intellectual Property Rights (IPR) arrangements for your project?

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. On creation of Foreground IPR the creator of the IPR will notify the project partners to enable it to be recorded and ownership agreed in line with the contract terms.

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 beagreed.

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.

Commercialisation, route to market and business as usual

How will your idea become business as usual within your network and across the other networks?

Commercialisation and BAU
The Discovery phase considered the implementation of this system across the UK Gas Transmission network post delivery of the demonstration in the Beta phase. This project could enable more efficient hydrogen production improving the cost effectiveness of hydrogen deployment on operational sites.
We have considered our approach not only based on the Beta demonstration site but other network sites to understand the difference in costs and approach for deploying waste heat recovery. The demonstration site for Beta has an opportunity beyond the network assets; industrial and transport hydrogen users in the vicinity who are looking to connect to the hydrogen production unit to help them decarbonise. This project will be demonstrated at Beta alongside other SIF projects including HyNTS Hybrid Storage and UKPN's Connectrolyser to provide a wider systems approach to energy storage and utilisation.
The demonstration is planned to take place on an active site, and therefore will require the necessary changes to physical assets, control systems as well as policy and regulation, which would then be applicable to a large proportion of sites on the NTS. This will require engagement with relevant internal teams including asset strategy, asset management, rotating machinery, control systems andhydrogen. These activities required through Alpha and Beta will stand us in good stead to understand the approach to deploying this solution across the widernetwork and UK applications.
The Beta demonstration will deliver key evidence which will feed in to our price control business plan and hydrogen projects such as Project Union, enabling this solution to be rolled out across the network.

Commercial Readiness of Partners

Waste Heat Recovery (Alfa Laval) is an established technology, already producing and installing these units at scale for gas turbine applications. The link to the solid oxide electrolyser is novel, however the Discovery phase has determined that steam can be produced at the required conditions.

HydroGenus are aiming to become a leading developer of low carbon hydrogen hubs in the UK, providing resilient, flexible and cost effective supply to local hydrogen users. HydroGenus are involved from the feasibility stage through to front end engineering and design and Engineering, Procurement andConstruction. HydroGenus previously supported the NIA 'Hydrogen Fuel Gas forNTS Compressors', and are currently supporting the SIF Hybrid Storage project and UKPN's Connectrolyser project, so will be providing a wider commercial viewof the proposed hydrogen hub at Duxford.

Anglian Water will be responsible for determining the water supply, connection, treatment and storage requirements through to engineering design in the Alpha phase. This will be carried out through their BAU teams as well as Alpheus Ltd who are part of the Anglian Water group.

Cardiff have extensive knowledge in gas turbine combustion and operation, and are supporting this project by providing benchmarking and peer reviews of our approach. In the Alpha phase, they will also carry out modelling and simulations to optimise the system efficiency.

Senior Sponsor Involvement
This project is endorsed across all levels of management. The innovation team willbe responsible for the delivery of the project and ensuring value to the businessthrough implementation across the NTS. The project is supported by:

Subject Matter Experts for our operational equipment, ensuring the correct levelof evidence is gathered to enable implementation

Operational teams to ensure the required changes to site are met for thedemonstration

Policy and Regulation teams to ensure the correct approach

The project has been presented to the senior leadership team and CEO whom are in full support of the project and excited to see the projects come together in Beta as a demonstration of this fantastic opportunity.

Policy, standards and regulations (not scored)

Do you consider there to be any barriers with respect to meeting the requirements of regulations, policy or standards?

Project regulatory barriers
There are no regulatory barriers that prevent the delivery of the project through Alpha. There are no policy changes required for us to fuel our network equipment with hydrogen and this could be utilised prior to hydrogen being injected into the network to decarbonise emissions from our network compression assets in line with the 2030 MCP emissions requirements.

In Beta we are looking to deploy this project alongside HyNTS Hybrid Storage and Connectrolyser on an operational site which will require permits, early engagement to ensure these are attained will be required through the Alphaphase. As the project will not inject hydrogen into the gas network no derogations will be required for Gas Safety Management Regulation (GSMR), however with hydrogen on an operational site and interacting with network assets we will need approval from the HSE. We have been informed these deviations will take a minimum of 13 weeks and this will be considered in the Beta phase.

In the Alpha phase we have a deliverable to review land rights and permits for the electrolyser to be situated on our compressor station and to deploy the heat recovery and storage mechanisms required for the Beta project elements covered by this project. HyNTS Hybrid Storage and Connectrolyser will consider the other elements associated to hydrogen storage and electrical connections to the site and feed into the central steering group for the Beta application.

HyNTS compression is developing the evidence required to deploy hydrogen as afuel gas on the gas turbine and will complete this by April 2025. We will build this timeline of evidence and review into the Beta phase deployment of this project. We are actively engaged with the HSE to ensure the NTS safety case for hydrogen and hydrogen blends is ready for Project Union commencing in 2026. This project and its findings will be integrated into this plan to ensure consistency in approach and alignment.

Longer-term regulatory barriers and policy requirements
The deployment of hydrogen on gas networks in the UK has not yet been finalised, however many exploratory demonstrations have been sanctioned across the UK. As we progress past Beta we will need to ensure that the opportunity to duplicate the demonstration is available for other sites. There are several policy and regulatory systems in review around the introduction of hydrogen considering both 100% hydrogen and blended hydrogen. Primary and secondary legislationwill need to be updated to enable blends of hydrogen within the network and allowfor the development of a 100% hydrogen NTS. Alongside this, rules will need to be agreed, such as the uniform network code (UNC) and GSMR to incorporate hydrogen blending and if required adapted for hydrogen transportation.

This does not directly influence this project as we will not be utilising network hydrogen or injecting into the network, but this is an opportunity for the future.

Evidence creation to influence future policy and regulations

The project will create evidence for the HSE and relevant stakeholders on the deployment of these systems, which will look to follow the approach utilised by the Hydrogen Grid Research and Development (HGR&D) working group. 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 HGR&D and Gas Goes Green (GGG). Evidence of our network scapability 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.

Value for money

What are the Alpha Phase Project costs and how are they proportionate to the Project delivery?

Project Costs and SIF Funding Requested

The total project cost is £429,703 including £42,971 contribution (10%) and we are requesting £386,732 of funding. The funding is split across the partners as follows:

National Gas Transmission - £77,126 (18% total project) (£42,971 contribution) seeking £34,155 of SIF funding. Project management activities, business case and requirements development, solid oxide electrolyser requirements and tender process.

Alfa Laval - £139,600 (32% total project) - waste heat recovery design, site surveys, HAZID/HAZOP, steam turbine design

HydroGenus - £78,375 (18% total) - finance strategy, electrolyser requirements and procurement strategy (supporting NGT), electricity connection, widerhydrogen hub development.

Cardiff University - £82,624 (19% total) - peer reviewing and system optimisation through modelling.

Anglian Water - £49,800 (12% total) (of which £24,492 is costs forsubcontractor Alpheus). This includes costs for sampling activities in the local water courses around the proposed sites and engineering design of the water treatment and storage elements.

SGN - £2,178 (1%) - supporting role feeding in outputs from Carnot Gas Plant SIF project

The split of funding shows that Alfa Laval will be carrying out most of the work in the Alpha phase, delivering detailed design and costs of the system to be demonstrated in Beta.

Compulsory Contribution
£42,971 contribution will be provided by National Gas Transmission which meets the 10% financial contribution requirements for Alpha.

Associated Innovation Projects

○ Yes (Please remember to upload all required documentation)
◉ No

Supporting documents

File Upload

Cardiff SIF Alpha report final redacted.pdf - 1.7 MB
8234 Alpha Phase Project Completion Report v1 Redacted.pdf - 24.3 MB
SIF Alpha Round 2 Project Registration 2024-01-17 2_08 - 112.8 KB

Documents uploaded where applicable?

☑