SIF Alpha Project Registration

Date of Submission

Dec 2022

Project Reference Number

10037368

Project Registration

Project Title

Thermal Imagery Analysis

Project Reference Number

10037368

Project Licensee(s)

Northern Gas Networks

Project Start

Nov 2022

Project Duration

6 Months

Nominated Project Contact(s)

Michael Charlton - mxcharlton@northerngas.co.uk

Project Budget

£525,075.00

Funding Mechanism

SIF Alpha - Round 1

SIF Funding

£469,356.00

Strategy Theme

Data and digitalisation

Challenge Area

Data and digitisation

Project Summary

as possible to protect our climate. This project has undertaken a discovery phase as a primary step to support our vision to provide a network tool and a UK assessment capability.

The aim of this project is to support a safe, environmentally conscious, and cost-effective transition in as many existing assets as possible. This can inform how much and where legacy assets need to be replaced and/or maintained, providing an operational tool for both natural gas and Hydrogen leakage management supported by a digitised inspection process. Leakage of Hydrogen into the atmosphere during the production, storage, distribution, and utilisation will partially offset some of the benefits of a hydrogen-based economy [N. Warwick Atmospheric implications of increased Hydrogen use, 2022], meaning that leakage reduction is a key priority whichever fuel a pipeline carries.

To support gas networks reductions in emissions, whether hydrogen conversion is or isn't progressed, we have developed the capability to detect leakage from within live gas filled pipelines using a prototype sensing system. This means that we can inspect pipelines for leakage under a number of scenarios, which are crucial to help achieve Net Zero targets. These scenarios could include:

pre conversion leakage pinpointing, natural gas leakage detection and repair (LDAR), and Hydrogen leakage identification. This is completed in a minimally invasive way, scheduled ahead of conversion programs to minimise unplanned workloads and time off gas for consumers.

The solution uses live access sensing to analyse the internal characteristics of a pipeline transporting natural gas, and simulate changes, typically in the form of deterioration or leakage that may occur through changing factors such as gas type or pressure. Any capture data will primarily provide assurance and evidence to networks to enable a more in depth understanding of the current and future risks associated with legacy assets.

Project activities would focus on gathering any underlying condition data through sensing to support conversion strategies and build confidence in a common approach to advanced leak detection across UK networks. The project aims to test and understand the viability of leakage sensing for conversion assessment to minimise any uncertainty around pressure elevation to maximise the retention of current assets.

Project Description

Project to test different solutions for digitisation, gathering user requirements across GDNs. Introduce, demonstrate, and gather feedback on Proof of Concepts for the “Push Rod LeakVISION (which enables Tier 1 works) to de-risk hydrogen operation with a DNV hydrogen test deployment, and to build a project plan for Beta.

Preceding Projects

10027276 - Thermal imagery analysis - Condition assessment fluid and pressure

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Project Approaches And Desired Outcomes

Innovation Justification

Networks are a mixture of metallic and Polyethylene (PE) assets which were first installed in UK gas networks in 1969. Several grades and manufacturers exist, and over the last 50 years there have been major changes in installation techniques, tooling and fitting designs. Hydrogen transition for energy, heating and transport requires assurance that current assets are capable to carry this new gas. As networks adopt hydrogen, there will be challenges including combustion ranges, combustion characteristics, and higher leakage rate potential (which may permeate and diffuse differently). Hydrogen's higher leakage potential, wider combustion range and lower ignition energy present new challenges for gas networks.

Existing LDAR methods include acoustic detection, above ground gas sensing (methane, tracer gases and above ground thermography), exploratory excavations, electrical continuity, and pressure testing. Although acoustics work well in water pipelines, they are impractical for low-pressure gas leakage which is typically silent. Iterative excavations and rock drilling usually involve multiple excavations and disruption. Gas sensing from above ground is also iterative and can miss subsurface leakage tracking. LeakVISION offers a new approach and creates a new field for academic exploration.

There are numerous projects aimed at PE / network assessment and suitability for hydrogen. Our project reinforces learning with the new sensing and digitisation capability. We are actively engaging and sharing knowledge with projects such as NGN H21 and SGN H100. The impact of not progressing this project misses an opportunity for UK technologies and industry to pioneer strategically significant hydrogen transition and net zero supporting technologies.

Identifying pipeline leakage, defects and distributions will inform the most cost and societal risk effective replacement, repair, or monitoring methodology. This brings new condition data through direct inspection and public reported escapes. This data, digital technology, and Artificial Intelligence (AI) will help prioritise and automate pipeline remediation and replacement investment strategies by enabling the evaluation of both costs and opportunities of repurposing existing asset infrastructure.

The technology is new and therefore uncertain. To build datasets a substantial body of experimental field validation work is required. This and the data that is produced has significant short- and long-term gain for UK domestic gas infrastructure, climate pledges, and UK engineering, technology, and robotics fields.

There are various risks that surround the project. These are highlighted in the risk register included in the Question 5 appendix. These risks and the large-scale requirement of data gathering and technical optimisation of a new and novel sensing technology within highly regulated business is challenging; it is not considered a business-as-usual activity. The robotics that have been prototyped are truly pioneering and do not have established commercial or business models. This is a growing field that applies cutting-edge technology and research to an extreme environment in a strategically important field.

Preparation for hydrogen and scalability of LDAR (methane/hydrogen GHG) to meet net zero goes beyond normal operations for networks. We believe that this project should be funded through the SIF mechanism as capturing and utilising the new data is not currently considered with price control decisions. The Beta pilot will generate insight with the potential at scale to help networks challenge the globally high costs associated with LDAR (IEA 2021, Methane Tracker 2021, IEA, Paris), essential to providing heat, transport, and power with minimal climate warming, irrespective of pipeline gas.

We believe that SIF and the regulatory oversight provided will better position us to propose supplementary funding and network rollout. This could be though a strategic program to stimulate cuts in LDAR costs. This highlights the UK's leading role in global climate change challenges and promotes international routes to market.

Benefits

Decreasing leakage is a climate change goal. The project advocates hydrogen transition and the decarbonisation of the distribution system. This next generation digital inspection and assessment product is a tool enabling improved planning, modelling, and forecasting of resilience, replacements, and investment risk.

Reducing the cost of conversion helps those in fuel poverty. Reduced interruption is key for vulnerable consumers. The ability to plan and prioritise replacement is in direct alignment with the UKs ambitious net zero targets and the recent COP26 methane pledge. By increasing average conversion productivity by as little as 0.5% we could save enormous levels of carbon emissions and cost. As a benchmark, traditional CCTV systems for live gas inspection for the 30/30 mains replacement program are estimated to have increased productivity by 25%.

Our discovery project developed a detailed quantified benefits framework working with a number of stakeholders across Northern Gas Networks. We have summarised assumptions and values across our range of use cases to produce a high-level set of benefits in summary annex. A detailed example is available in the annex with underling detailed on build up. We are looking to test this model across networks in the Alpha and Beta to agree acceptable central benefits cases, promote common understanding and critique.

There are four routes through which carbon is reduced by this innovation:

- By supporting effective hydrogen transition that replaces methane
- Maximising current asset retention for hydrogen and associated carbon
- Pinpointing leakage internally to detect and lower methane leakage through targeted repair
- Minimising replacement by pinpointing leakage for cost-effective repair

Customer Impacts
Conversion cost savings by promoting asset retention

Faster and more efficient method for reactive leakage pinpointing

Potential for reduced excavation and inconvenience (repair/replacement)

End User Impacts
Increased transition productivity (and associated carbon saving)

Additional costs / material usage as networks repair detected leakage

Potential for job displacement through inspection and robotics (leakage teams diminished)

Research requires district pressure increases (risk to consumer, costly to GDN) changes to established working practices

Creation of additional innovation avenues

Wider Stakeholder Impacts
Reduces uncertainty of hydrogen conversion costs and risks

Encourages highly skilled technology job creation in Northern England

STEM field and UK climate pledges PR

Aids gas networks risk assessments (QRAs)

Environmental Impacts
Increased hydrogen conversion speed mitigates emissions

Decrease in associated carbon from repair/replacement optimisation

Methane leakage reduction (equivalent carbon saving in line with COP26 guidance)

False positives would create additional wastage to address

Inspection associated carbon cost

Material usage and waste associated with repair, R&D, and regular maintenance

Commercial Impacts
Reduction in rework by repair pinpointing and associated cost saving Supports local and domestic manufacturing supply chains

Saves capital and risk long term (earliest possible repair)

Export opportunities

Increases short term capital use (earliest detection and repair) - pull forward

Risks And Issues

We have built a detailed risk register for the project across the Alpha, Beta and implementation phases. Our risk register covers the main technical, commercial, regulatory/legal, recourse risks across the Alpha stage and risks against the wider program that the consortia are currently aware of and tracking.

The methodology that has been adopted is similar to that documented by Becker (2004) following PMBOK guidance on risk definition. We have and continue to identify, evaluate, and respond to risks at each stage of the project. The suitability and effectiveness of controls and mitigations will be reviewed periodically in project meetings. We will review across the parties and question stakeholders at engagements for views on risks, which will be added where necessary. We will also use stakeholder events as a key communication channel to raise awareness of risks and controls with relevant stakeholders.

The key risks are associated with the generation and acceptance of suitable risk/rewards for network assurance and operational efficiency. These are included in the detailed risk register and are highlighted with specific risks 8,9,19 & 20. There are external risks around hydrogen or gas network abandonment that cannot be directly mitigated.

Our assessment of our actions, mitigations and tactics is to broadly lower risk probability. Risks will become less probable where mitigations are available but may still remain severe. Where these severe risks remain, they are typically through externalities (e.g. hydrogen for heating decision, risk 12) which we have mitigated for example by developing insensitive/parallel value streams, diminishing the overall program impact. We are promoting the program of works (having just won the IGEM innovation award) to gain industry visibility, risk awareness and earliest identification.

The largest leading risks to the completion of the Alpha phase are the outcomes of hydrogen testing for networks (12), increasing consortium size (26, 27), scope drift (30), implementation provision (34) and technical credibility of a small-scale push rod sensor (18). All these risks have mitigations in place and are documented.

Management risks include potential future lockdowns (23) and the complexity of the project in terms of all the tasks required to move the concept into practice (22). Occurrences that pose an unacceptable level of risk will have mitigations to reduce the likelihood and impact to an acceptable level of consequence such as minor delays. The Risk Register will be reviewed during the project kick-off meeting(s) and at project review meetings (added to project plan).

Key constraints remain around commercials and resourcing for rollout. We will test within the Beta constraints and assumptions around what level of inspection is required for PE during conversion. Regulatory constraints are focused on risk acceptance, technical scanning ability for given population densities and implementation assistance.

We have identified a potential scale barrier associated with implementation funding and routes after Beta (34). We aim to navigate this with additional communications and industry championing. Therefore, the SIF program is advantageous over other schemes by granting regulatory oversight to the proposed supplementary GDN funding for strategic LDAR initiatives.

Synovate has created an innovation which is patent pending. We had completed a prior art search ahead of patent application and are working with our IP attorney through International Patent Office (IPO) proceedings, ensuring and testing that freedom to operate remains an ongoing concern. IP issues will be raised to the named leads and assessed by the team and IP / IPR specialists for solution.

Certain risks may become unnecessary constraints over the next stages of the project; the unknowns surrounding the H2 transition and government’s strategy will become clearer, and financial options will become established as funding timescales progress.

Project Plans And Milestones

Project Plans And Milestones

We aim to evolve condition assessment processes establishing better planning, investment risk cases and QRAs for the conversion of gas assets to hydrogen. The products, processes, networks, and competencies we will expand to add benefit across multiple stages of the anticipated life cycles, from managing a natural gas network to planning, transitioning then operating a hydrogen network.

We will use the Alpha phase to retire or reduce risks especially those that score highly and/or are foundational to the project. We will test different solutions for digitalisation using cross industry SME partners and Digital Catapult to assess the most viable route to market. We will aim to workshop and engage with data stakeholders and build experience and a Proof of Concept (PoC) with our digital platform partner iTouch. The broad aims of the Alpha project are to:

- De-risk and test solutions for digitalisation (iTouch vs Digital Catapult)
- De-risk and test solutions for small diameter sensing
- De-risk hydrogen operation
- Test benefits case solutions across networks and de-risk assumptions
- De-risk digital transformation

To achieve these objectives our work plan for Alpha phase covers 8 work packages, that will be completed in the 6-month allowable window. The work packages that we will complete are:

1. End to End digitalisation requirements
2. Digital & AI system definition
3. Digital interface Proof Of Concept (PoC)
4. Push Rod PoC
5. Hydrogen Operation
6. Scalability
7. Detailed Beta phase plan
8. Project management

The resources that are required are technical (covering mechanical, electronics, gas, digital systems) and business (to establish and grow our value propositions). To evaluate scalability we need network endorsement to gain trials or assessment, and good engagement resources. We are currently in conversation with two other UK gas distribution networks to arrange early trialling of LeakVISION to further understand user needs and develop their operations cases and test our value assumptions.

The success criteria will assess if we are able to either provide sufficient planning, risk understanding and mitigation and assumption definition that we can produce a winning assessed beta bid OR that we can rule out a beta application.

We have created a detailed plan for Alpha stage and produced a Gantt chart. Our project plan annex details our work package and highlights main partner responsibilities. This includes milestones and deliverables alongside key tasks aligned to the guidance template format. We will complete initial detailed planning to boost inter-partner communication and support across partners at kick-off. We will have internal meetings monthly to review progress, challenges, and issues as well as plan progress, resourcing and the risk register. These will be supplemented with informal bi-weekly calls to connect and align the partners. During the kick off stage we will add in monitoring requirements and any special requirements across the consortium. Risk and challenges will be documented and escalated where there is no resolution within one month to the partner leads.

We have added iTouch, Digital Catapult, and the University of Sheffield into the team. iTouch is an implementation partner for the digitalisation of the LeakVISION field reporting and back-office connectivity. Digital Catapult brings Industrial IoT expertise to technically assure iTouch's implementation using Ai and ML expertise to assess the automation potential of leak detection with these techniques, along with setting out the appropriate AI governance framework to accelerate progress to rollout. Finally, the University of Sheffield is our academic partner to support cross-sectoral knowledge dissemination.

Regulatory Barriers (Not scored)

Whilst there are no regulatory barriers that hinder the Alpha or Beta projects, there are currently no provisions in the price control mechanism to support strategic implementation across the UK gas industry into Business as Usual (BAU). Adoption at pace will require wide scale collaboration and support from both gas networks and policy makers to deliver energy transition and net zero agendas without hindrance to existing gas operations.

Our approach to overcoming this issue is to continue to engage with industry leaders, stakeholders, policy makers and strategic partners. We aim to spread the vision and recruit key champions to support the project aim. Our Alpha project will aim to identify any potential charitable organisations that could support our Beta and promote the transition into BAU.

Business As Usual

We believe there are many routes to market from the learning, innovation, and associations fostered by our project. The minimum viable product (MVP) would be a leak detecting thermographic pushrod camera. Linked digital infrastructure would allow networks to pinpoint, digitise and evaluate condition and leakage risk for primarily PE assets.

NGN are the first UK network operator to embed pipeline maintenance in their business, having put into practice the System Two Assess and Seal Solution (STASS) since 2017 to repair leaking cast iron joints. Leakage condition assessment provides a transformative method to simulate hydrogen networks and builds upon our aim to pioneer new areas. NGN operate a six-step process to ensure successful business wide innovation adoption.

Central to implementation is support from all relevant business units. The NGN Innovation Team connects all third parties and external innovators to these resources and decision makers. The key connections for this project include the 3IG (NGN Digital) Team, Operations, Asset Strategy, business leadership and our Regulation and Strategy Team.

- Innovation Teams will provide facilitation and co-ordination
- Operations will provide technical expertise and sponsorship
- 3IG (NGN Digital) provide System Integration support
- Asset Strategy will provide long term vision investment strategy support
- Regulation and Strategy Team will provide steering and guidance

To share learning with other licensees we support knowledge sharing, expertise, and promotion. Critical to this is industry-wide backing and steering. As such, we continue to engage at a sector level and have recently (May 2022) won the IGEM "Innovation of the Year" Award, which is increasing visibility and cross-GDN traction. This will continue in Alpha and generate UK wide digitalisation requirements tested against NGNs own assumptions through engagement with other GDNs.

We are advocating the adoption of our learning through engagement with PipeBOTS to help disseminate the learning academically across sector boundaries. By selecting appropriate partners with existing technical and commercial bases, we believe this gives us a strong opportunity to roll out this innovation rapidly.

There is no known competition to this value proposition. There are many leakage detection solutions, either acoustic or above ground, but none that pinpoint leakage internally at low pressures in live gas assets.

There are many routes to digitisation, and stakeholders whose needs must be prioritised and progressed along our core theme of large-scale LDAR. A primary objective of this project is to stimulate the learning, innovation and our local economy, capability, and skills. A central requirement for effective utilisation is that the team and supply chain establish and retain the required skills and competencies to manage, develop and expand this solution after our Beta pilot. Our Alpha work de-risks this by testing multiple support mechanisms to enable the cross-party digital transition, evaluating the best route to establish this capacity for supply chains into employment without outsourcing. We aim to promote retention within the partners. Key to this is establishment of market and local capability; allowing the partners to address wider market opportunities.

We plan to evaluate the technology thorough the SIF program and investigate opportunities to make established business cases to support the implementation funding requirements. We are engaging with stakeholders across the business and sector to establish the level, needs and opportunities to make these informed cases and requests.

Commercials

Commercialisation

To our knowledge, there are currently no scalable solutions for the in-pipe detection of leakage from low pressure gas pipelines. We therefore do not compromise competitive markets and aim to stimulate reduction in costs associated with detection.

We have identified nine use cases for our technology. These opportunities offer advantages along the energy transition journey should we or should we not see hydrogen conversion at small or large scale.

The conversion to a hydrogen economy could require a distribution investment of £23.7Bn (ENA, gas goes Green, 2020) whilst UK methane distribution leakage in 2020/2021 is estimated between 97 to 105 kt.

With LeakVISION we aim to strategically boost hydrogen conversion productivity and ease the cost of Leakage Detection and Repair (LDAR) which is a high proportion of global gas network abatement cost curves (IEA 2021, Methane Tracker 2021, IEA, Paris).

We aim to benefit our customers by detecting leakage from inside gas pipelines, to allow the detection and treatment of leakage as quickly and cost effectively as possible. We support the demographic shift in this industry by digitalising in-field site inspections for the next and sizable generation of gas engineers required for the transition. The value that this brings to networks is the potential for transition productivity savings and mitigation against the rising social costs of carbon equivalent.

The value that this innovation brings to consumers is much larger. The technical value establishes the UK as a leader technically and proactively in net zero and transition technologies, boosts highly skilled jobs across the North of the UK backing the levelling up agenda, and advancing the green tech sector. The ability to transition to net zero at the lowest cost has huge economic and environmental gains. Doing this in a low impact, minimally invasive way which reduces necessity for access into customers homes and minimises excavations, is hugely important; especially for the most vulnerable.

Our primary and go-to market customer segment is UK Gas Network Operators. As the net zero and transition agenda evolve, we also expect that the gas sector supply chain may own or operate the solution. Initially we will look to partner with GDNs for delivery but we have carefully considered the deployment format to align with common inspection systems used in the 30/30 replacement program. This means that there is a population of skilled UK gas operatives already, who have a good technical basis to operate the equipment. Our partner iTouch also has experience in scale deployment of in-field data capture systems in the drainage sector.

Internationally, there are a number of territories that operate low pressure gas pipelines where many of the same benefits cases apply (e.g. USA). There are also parallel opportunities in other sectors where the same sensing methodology and research could assist areas such as drainage infiltration.

In Alpha phase, we aim to identify potential charities that can back the vision of the project thorough a new partnership. We believe that this new partnership, if done correctly, can expedite our successful route to market.

Synthotech (the parent organisation for Synovate) re-invests heavily into research and development and new products. We are also in conversation with current and potential funders on working capital and CAPEX requirements for deployment and consignment. We have letters of support available from current partners (available on request). As a business already specialised and working in R&D within the sector, we believe that our current additional capital requirements are low. If we are successful with Beta and gaining regularity and GDN patronage, we believe that we can also be effective in scale delivery owed to our existing market positioning.

Intellectual Property Rights (Not scored)

All partners have agreed to and will sign a standard set of terms for correct management of IP & IPR generated during the project.

As University of Sheffield is an academic institution, foreground IPR will be discussed and published, in line with section 9.16 of the SIF Governance document.

Synovate has created an innovation which is patent pending. We had completed a prior art search ahead of patent application and are working with our IP attorney through International Patent Office (IPO) proceedings, ensuring and testing that freedom to operate remains an ongoing concern. IP and IPR issues will be raised to the named leads and assessed by the team and specialists for solution before timely escalation.

Costs and Value for Money

The total eligible project costs for the Alpha phase are £525,075. The funding requested is £469,356. Partners are endorsing the work with in-kind contribution and are financing their contribution from retained earnings which would otherwise be spent on other product development, research activities and technology progression.

The activities are modestly costed, and rates are closely monitored in line with industry. The project represents great value for consumers, supporting investment into utilities research where similar products have yielded considerable productivity enhancements. The largest Synovate contributor to the project cost is labour, with the finances being spent on technical roles in robotics and advanced inspection, based in Northern England where such roles are rare and valuable. The costs for industrial research represent excellent value for money for the level of service and capability imparted. Key partner resources will be allocated to this project, representing significant commitment of commercial direction for the SMEs. We have worked to lower rates in line with discovery assessor feedback. This has been made possible as Alpha project timelines have been extended. Synovate will review rates again for Beta deployment where longer timeframes may allow for increased efficiency. Alongside rate reduction, Synovate and GDNs have increased project contributions to bring in additional non-contributing partners which we hope demonstrates our commitment.

Within Northern Gas Networks (NGN), the costs are modest and are for this stage primarily labour. These represent excellent value in advancing understanding around effective hydrogen transition. NGGT has the smallest workload and grant request to support the needs and benefits cases. Where required we will reinforce the project with necessary subject experts from throughout the business. National Grid partnership represents unprecedented value in support and experience to aid in framing problems and requirements from a transmission perspective, playing a key role in understanding the hydrogen inspection / testing at H21/DNV.

Digital catapult / University of Sheffield are unable to contribute to the project based on funding rules. As such the consortium has sought to manage levels and balance aggregate contributions financially across the implementation partners who are making up this shortfall. This is a large undertaking for the SMEs advocating both funding split and additional contribution. We hope new partner involvement is seen favourably by assessors as a signal of dedication to delivery of industry-leading innovation, as we test digitisation options for Beta stage partnering.

For the Alpha phase the costs are low relative to the expected benefits cases and social cost of carbon savings possible, from very modest productivity increases during conversion programs. The breakdown of costs and funding allocation is as follows:

Northern Gas Networks	£ 19,130	£ 13,391
National Grid	£ 2,520	£ 2,520
Synovate	£ 321,250	£ 282,700
iTouch Systems	£ 95,250	£ 83,820
University of Sheffield (PipeBOTS)	£ 7,500	£ 7,500
Digital Catapult	£ 79,425	£ 79,425
Total	£ 525,075	£ 469,356

Supporting Documents

Documents Uploaded Where Applicable

Yes

Documents:

SIF Alpha Project Registration 2022-12-22 8_54

LeakVISION SIF (Alpha)_Deliverables, Risk Register, Milestones (REDACTED FOR ENA SNP).xlsx

LeakVISION SIF Alpha v0.51.pdf

MO_EndPhase_ProjectUpdateSlidea_0.1v.pdf

Show and Tell draft - Alpha phase.pdf

10037368 SIF Alpha Close Down Report 2023-03-02 10_56

SIF Alpha Project Registration 2024-02-20 11_04

This project has been approved by a senior member of staff

☑ Yes