

# Innovation Annual Summary



2022/23

# Welcome

## to the SGN Innovation Annual Summary 2022/23.

Welcome to SGN, where we are dedicated to paving the way for a safe, efficient and decarbonised future gas network.

In 2022/23, we proudly introduced an array of innovative products designed to transform the energy landscape. Our achievements include pioneering zero-carbon heat systems that harness the power of clean renewable energy. At SGN, we are at the forefront of cutting-edge research, actively exploring how the gas network can play a pivotal role in achieving the national pathway to net-zero emissions. Our unwavering commitment is to provide decarbonised heat solutions for homes, industry and transport, and we warmly welcome you to join us on this transformative journey.

### About us

We are one of Great Britain's (GB) largest utility companies, distributing natural and green gas safely through our 74,000km of pipes to 5.9 million homes and businesses across Scotland and Southern England.

### Our vision

To give our customers the best clean energy experience.

### Our purpose and strategy

Serving our communities by keeping everyone safe and warm.

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## Message

As the energy industry focuses on achieving a net-zero future, SGN has been actively engaged in collaborating with network and industry experts to develop effective strategies that can help achieve this ambitious goal. One of the key areas of focus has been on heat policy, which plays a crucial role in reducing greenhouse gas emissions, since heating is one of the largest sources of carbon emissions in the UK.

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Over the last year SGN has been collaborating with our peers and partners across the sector, working on innovations that improve safety, enable decarbonisation, or drive efficiency. The team have had success with projects such as Street Score 2 and Orbital Eye to name just a few (more on these later in the report).

For the remainder of the RIIO-GD2 period we will evolve our approach to innovation and our major focus will be ‘innovation as a service’ focusing most of our efforts on supporting our colleagues with the transformation of our performance.

This will translate into a refreshed innovation portfolio – reducing the number of projects we have in-flight with a greater focus on impact to safety, efficiency, decarbonisation, or customer need.

We are always open to new ideas – from our colleagues or industry – especially if they align to the priority areas mentioned above.”

**Selwyn Rose**  
**Head of Innovation**

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# SGN NIA overview

We are thrilled to present the 2022/23 Innovation Annual report, which signifies a significant milestone as the second report under the RIIO-GD2 framework.

Through the invaluable NIA funding, SGN and other Gas Distribution Networks (GDNs) have been able to embark on a journey of innovation, technology advancement development, collaboration and customer engagement. This funding has enabled us to explore a diverse range of ground-breaking initiatives aimed at shaping the future of the gas industry. We are proud to showcase the remarkable progress we have made in pushing the boundaries of innovation and we are excited to share our achievements with you.

Thanks to the RIIO-2 NIA funding, SGN has been able to undertake projects that not only address consumer vulnerability, but also provide long-term financial and environmental benefits to customers. This has allowed SGN to conduct crucial research into hydrogen production and distribution, carbon storage, and other innovative technologies that aim to revolutionise the gas system into the world's first green gas distribution network.

The projects within the organisation are continuously moving forward and making steady advancements, all in line with the Innovation Measurement Framework.

In addition to NIA, we have ventured into a number of projects under SIF and PCD to develop additional projects that support consumer and net-zero benefits. These are discussed toward the end of this report.

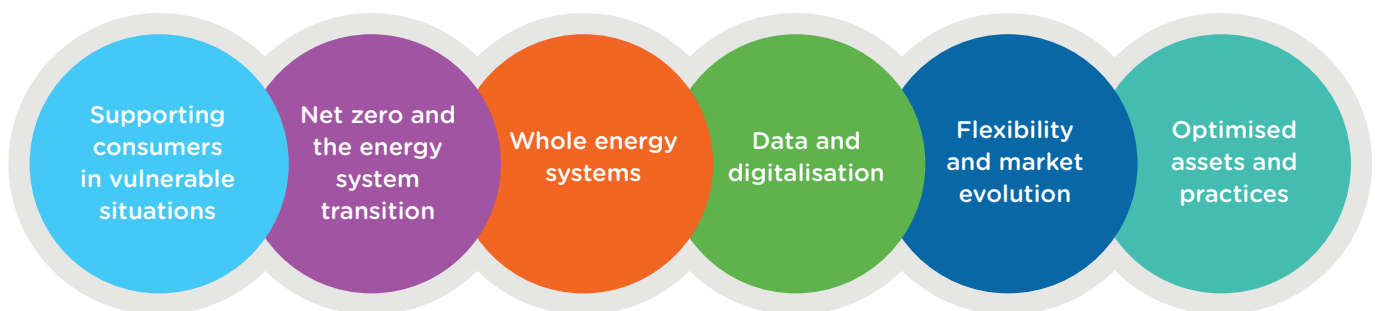
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Reflecting back on 2022/23 we have:

**53** live projects

**35** being led by SGN (**26** Lead only, **9** Lead with network collaboration) and **18** that we are supportive of.

These projects have aligned to the RIIO-GD2 challenge themes of:



# SGN System Transformation Strategy

The UK and Scottish Governments have legally committed to reducing greenhouse gas emissions to net zero by 2050 and 2045 respectively.

As part of this transition to net zero, demand for unabated natural gas must be phased out and replaced by low carbon and ultimately renewable energy sources. This will require the transition of natural gas connections to low carbon alternatives.

SGN's decarbonisation strategy is underpinned by the conversion of the gas networks from natural gas to green gases including hydrogen and biomethane, establishing an energy vector for low carbon alternatives and renewable energy. SGN aim to collaboratively provide evidence (feeding into heat policy decisions) to enable the system transition of the gas networks to hydrogen through an extensive programme of R&D and demonstration projects, including the hydrogen neighbourhood (H100 Fife), Multiple Occupancy Buildings and the The Local Transmission System (LTS) Futures Programme.

In parallel, system transformation projects are developing the plans, roadmaps, and infrastructure requirements to enable the conversion of the gas networks to 100% hydrogen. This activity is underpinned by the system transformation pre-FEED projects, which, across the East Coast and Central Belt of Scotland and the Southern LDZ, are designing and routing new hydrogen transmission pipeline backbones connecting hydrogen production, storage and network injection locations required for the phased conversion of the below-7 Bar distribution networks to hydrogen.

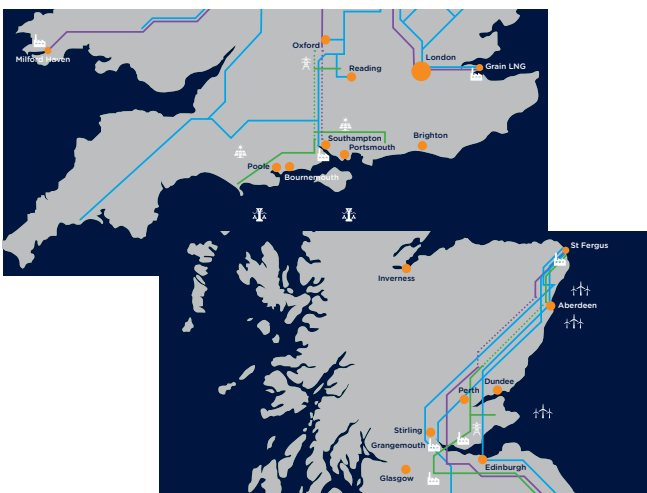
These in-flight pre-FEED projects and future pre-FEED and FEED projects represent the technical and commercial development of SGN's hydrogen rollout, which is aiming to demonstrate and ensure the timely delivery of the system transformation to hydrogen, feeding into heat policy decisions and enabling the timely delivery of the system transformation once the required policy decisions are in place.

SGN's three live flagship system transformation projects are the Southern pre-FEED, the Scottish pre-FEED(s) and Aberdeen Vision.

The Southern and Scottish pre-FEEDs are preparing the system transformation plans for the majority of the Southern LDZ and the East Coast of Scotland (south of Aberdeen) respectively through:

- Routing and designing H2 Connect and H2 Caledonia, the new systems of hydrogen transmission pipelines required to connect blue and green hydrogen production, hydrogen storage and hydrogen demands, including strategic network locations and industrial demands.
- Developing network conversion and sectorisation plans for each grid within the geographies of the projects, detailing the network reinforcements and adaptations required to sectorise each grid and establishing a strategy to transition each grid safely and progressively from natural gas to hydrogen, without compromising security of supply.
- Managing the interface between prospective hydrogen producers and storage operators, ensuring development timelines are aligned between projects.

Aberdeen Vision, which is near completion, has routed and designed the Aberdeen Vision Pipeline, connecting hydrogen production at St Fergus with the necessary PRS sites to enable the conversion of Aberdeenshire including the city of Aberdeen.

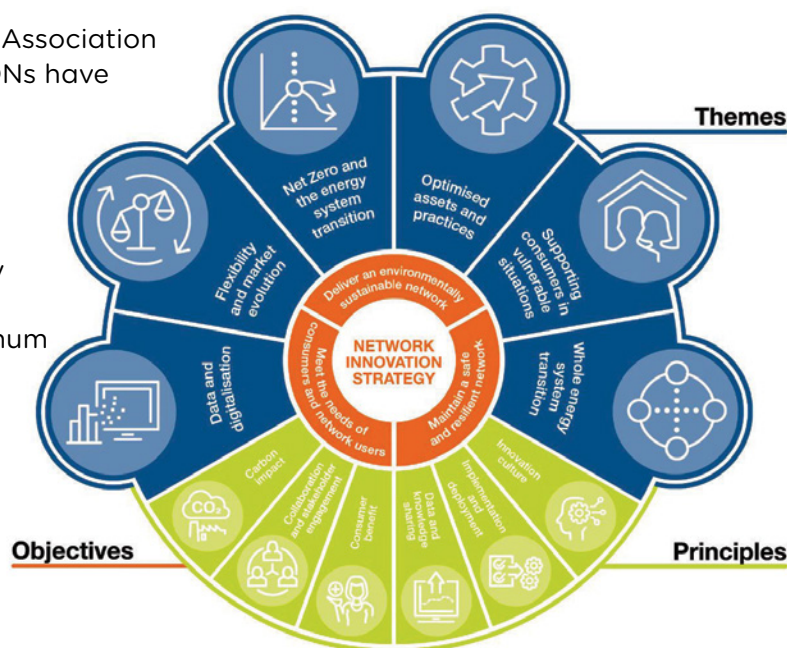


# ENA Innovation Strategy

In collaboration with the Energy Networks Association (ENA) and a range of stakeholders, GB GDNs have created a Network Innovation Strategy.

The strategy aims to meet the customer demands and industry challenges and it is key to ensure that new technologies and techniques are introduced into the industry in order to make operations safer for customers and staff while providing maximum efficiency of our operations. This whole system understanding aims to help tackle the wider energy challenges we face in transforming our energy system for a zero-carbon future.

This ‘**Network Innovation Objective**’ is reflected by key ‘**Principles and Outcomes**’ and ‘**Shared Network Innovation Themes**’.



The shared network innovation themes now include:



Exploring how best to support the needs of consumers who find themselves in vulnerable situations, today and in the future, to enable a just transition.



Developing and implementing industry-leading techniques for optimising assets and practices.



Develop joined-up approaches across sectors and energy vectors.



Facilitating and accelerating the UK's transition to Net Zero greenhouse gas emissions.



Developing and testing market-based solutions to increase the flexibility and efficiency of the energy system; accelerating the adoption of low carbon solutions.



Developing new data services and applying data science methods to harness the power of digitalisation to solve both system operation and wider stakeholder challenges.

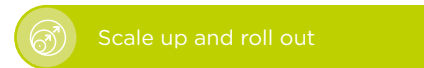
The underlying principles and objectives include:



We aim to focus our innovation activities to deliver clear benefit to our customers.



Innovation plays an important role in the UK achieving net zero-carbon emissions.



With completion of innovation projects, it is important to take the learning and output forward into the business.



Collaboration is key to ensure we continue to maximise value of our projects and delivery to our customers.



Collaboration is important in ensuring that we meet the needs of our customers, therefore we aim to make all information and data available where possible.

# Our project partners

Thanks to the NIA funding mechanism, we have an exceptional opportunity to expand our horizons and push technological boundaries to new heights. Our team loves to ponder the possibilities and we understand that the best approach to bring innovative ideas to life is by collaborating with forward-thinking visionaries who share our passion for advancement.

Through the years, we have forged strong partnerships with SMEs, as well as global corporations situated in Europe and North America, spanning various projects. SGN collaborates with prominent engineering and consulting firms to delve into hydrogen production, distribution, carbon capture and storage, and other cutting-edge technologies that seek to revolutionise the gas system, ultimately establishing it as the first completely green gas distribution network in the world.



“SGN currently use the High Volume Gas Escapes Tool to assist identifying and safely managing large gas escapes on the natural gas network. As SGN embark on operating live hydrogen trials with projects such as H100 Fife and LTS Futures, with hydrogen having different physical properties to natural gas, it has been vital to update the High Volume Gas Escape information, in the unlikely event an incident should occur.”

**Jo-Anne Elizabeth Tomkins, Principal Engineer, GL Industrial Services**

“In line with deltaflare’s mission vision to deliver technology advancements towards Net Zero, SGN and deltaflare have been collaborating closely to trial and deploy the Phoenix platform. The Phoenix IIoT platform has been developed in collaboration with the industry to provide Critical National Infrastructure grade cyber security to and pave the way toward a hyperconnected and distributed world.”

**Mo Javadi, co-founder and COO, deltaflare**

“We’ve been proud to work with SGN Energy Futures, Innovation, and Operations Teams across a range of projects. These include delivering new products, hydrogen safety case research, and addressing customers in vulnerable situations. Throughout these projects, SGN has been a great collaboration partner. Their employees are innovative and are happy to challenge the status quo; they are willing to share knowledge and expertise to create better results.”

**Iain Chirnside, Director, Steer Energy Limited**

“SGN’s leadership in developing the safety case for hydrogen distribution networks is providing key evidence for the future deployment of 100% hydrogen networks. Kiwa is proud of its recent NIA project work on Risks from Mains and Service Pipes which successfully closed evidence gaps and developed new insights which will inform the safety considerations for future hydrogen distribution networks. Kiwa looks forward to continuing working and collaborating alongside SGN in their industry-leading hydrogen research.”

**Sam Cottrill, Senior Energy Consultant, Kiwa Energy**



# Collaboration & shared knowledge

## Energy Innovation Summit

The Energy Innovation Summit gave a great opportunity to demonstrate SGN's commitment to innovation in the energy sector. Our stand generated significant interest and provided an excellent opportunity to exhibit our range of innovative projects which are driving the industry forward. Through our participation at various presentations, we were able to connect with like-minded individuals and organisations, and we look forward to continuing to work collaboratively towards a more sustainable future.



## Utility Week Live 2023

SGN attended the Utility Week Live conference, where we had the opportunity to present on our future of gas projects and its role in the energy mix. With customer vulnerability an important theme throughout the event, we were able to showcase our work that is helping to support customers that are in vulnerable situations now and to the future. Also during the event we launched the Robotic Roadworks Excavation Systems (RRES) robotic solution to the Utility sector with great interest and collaboration opportunities discussed.



## No Dig Live

As part of the No Dig Live event, SGN showcased our innovative keyhole technology solutions which aim to create sustainable and safe operations to reduce disruption for our customers. Within the conference, as part of the Green Alliance session,



RRES was presented demonstrating the various subsystem technology that the RRES project has developed.



## RRES Trials

With the exciting stage in the project, RRES underwent a roadshow of dissemination events. Demonstration of the innovation included the trials of the revolutionary solution to a range of different stakeholders across the utility sector showcasing all the different components of the system. Furthermore at the Utility Week Live conference, the system was unveiled to a wider audience and was part of a key note presentation.



## Innovation Basecamp

At the Energy Innovation Basecamp, trailblazers from across the energy sector will gather at a dynamic event, with a determination to break down the obstacles in the way of energy system innovation.

The Energy Innovation Basecamp is the first in a series of events which bring together Ofgem, Energy Networks Association, Innovate UK and all the GB electricity and gas networks to gain insights from innovators on how we can achieve a concise goal: to deliver a net zero power system by 2035.

## Gas Innovation Governance Group

We continue to work with the other GDNs at the Gas Innovation Governance Group, where we continue to share project progress, lessons learned and new opportunities to enhance knowledge dissemination and collaboration within the group. The purpose of the group is to ensure networks comply with the requirements of the licence condition by working closely to explore what technological, operational and commercial projects best suit the future needs of the gas networks.

## SHFCA Hydrogen Brokerage event

Scottish Enterprise and Scottish Hydrogen & Fuel Cell Association (SHFCA) partnered to deliver a hydrogen brokerage event at the MSIP Innovation Parc in Broughty Ferry, Dundee last August.



This was the third in a series of hydrogen brokerage events across Scotland, with previous workshops held in Inverness and Dumfries.

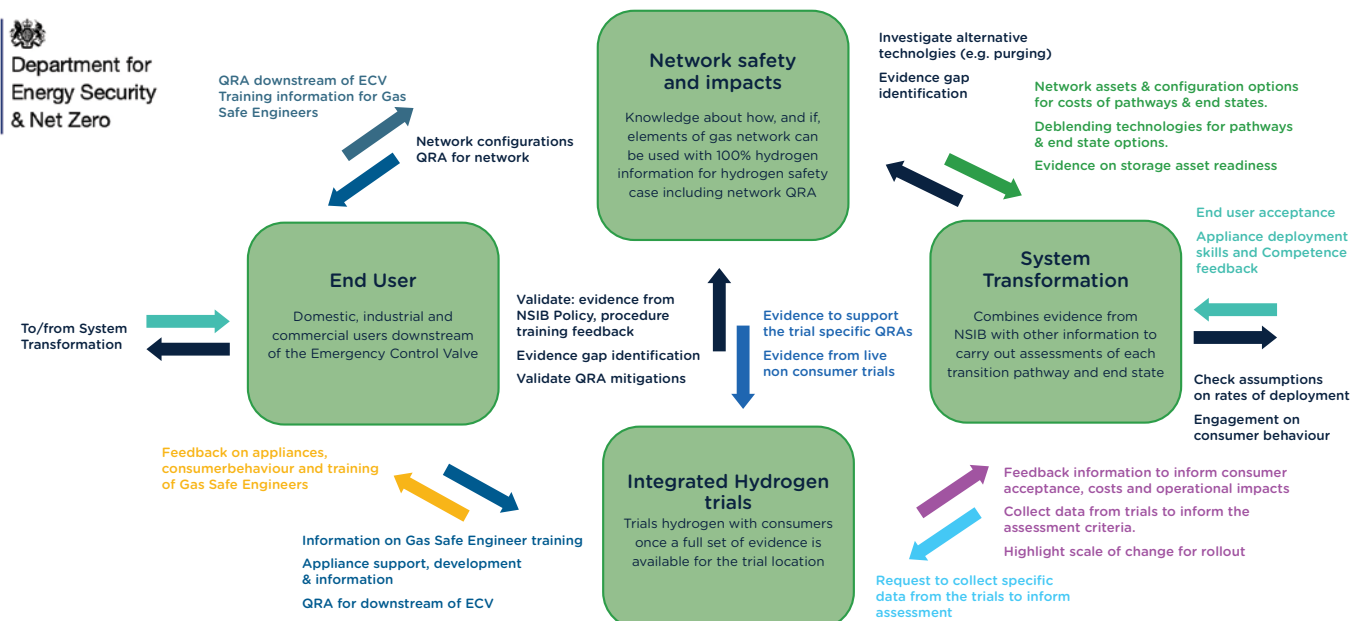
The morning session provided an overview of hydrogen as a wider commercial opportunity, expert speakers who are working on hydrogen projects presented their portfolio of projects, including Colin Thomson from our Future of Energy team. The event then focused on supply chain opportunities in projects encompassing production and the various demand applications for hydrogen.

During the afternoon session, three table-top discussions were facilitated with the speakers and other organisations driving the hydrogen agenda in Scotland.



## DESNZ Hydrogen Programme Management Board

We are working closely with Department for Energy Security and Net Zero (DESNZ), industry leaders and technical groups to review the end-to-end process around the system transformations for hydrogen use with feedback from end users.



# Network Innovation Allowance

## Innovation case studies

Innovation continues to be a cornerstone of SGN's approach to delivering safe and efficient methods of working for our customers and operatives. Through our commitment to investing in research and development, we can discover new and better ways to tackle the challenges we face in both the present and the future. By harnessing the latest technologies and techniques, we can offer cutting-edge solutions that enable us to provide our customers with the highest levels of service and satisfaction.

### Phoenix IIOT Demonstrator (NIA2\_SGN0004)

Supporting consumers in vulnerable situations



Net zero and the energy system transition



Whole energy systems



Data and digitalisation



Flexibility and market evolution



Optimised assets and practices

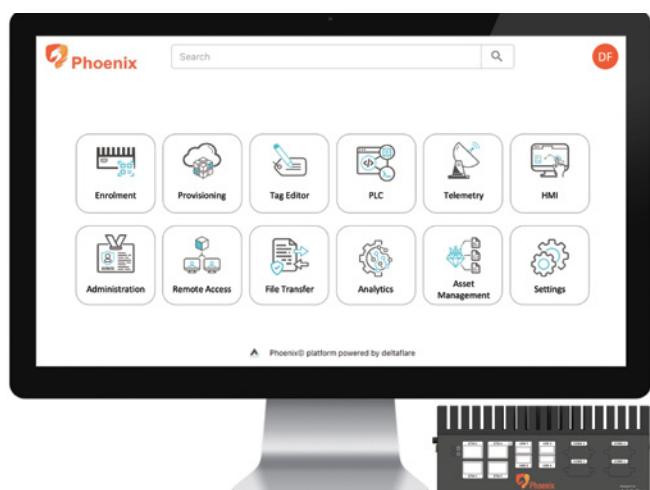


With the aging UK energy industry there is a requirement to modernise our systems to improve efficiency and longevity of our infrastructure, which is critical in meeting our net-zero targets. With the adoption of smart technology there is an increased risk of cyber-attacks, therefore it is essential that we implement a solution that provides maximum security of our infrastructure.

At present the industry uses traditional standalone industrial control system from a mix of companies, making good data quality very challenging. Attempts have been made to overlay IoT (Internet of Things) solutions, which creates more complexity and management of the digital asset and often leads to cyber security issues.

The project centres on a ground-breaking concept and to use trusted technologies which combines innovative advanced real-time control, with state-of-the-art cloud technology. The solution will be developed to allow a full sensor to cloud approach, reducing the human operator oversight at each facility and helping to extract real-time asset data into SGN's preferred cloud solution, allowing for data analytics and Machine Learning for automated network optimisation and predictive maintenance.

The project is entering its completion phase with work being carried out to demonstrate and validate the combined software solution with physical demonstrators at SGN facilities. This will continue for a few months until enough data is gathered. Following completion, the project looks to provide reduction in cyber risk, support Network Information System Directive compliance and the increased digital transformation capabilities within SGN.



## Grangemouth to Granton LTS Futures (NIA2\_SGN0001)

Supporting consumers  
in vulnerable situations



Net zero and the energy  
system transition



Whole energy  
systems



Data and  
digitalisation



Flexibility and  
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Optimised assets  
and practices



This project is a pre-feed for the LTS Futures project to allow the LTS Futures project timeline to be maintained while the project itself progressed through the NZASP (Small Net Zero Projects Re-opener and Net Zero Pre-construction Work) approval process. The main outputs of the project are:

1. An optioneering study for hydrogen supply for the Live Trial.

2. Defining the technical studies and experimentation required within the LTS Futures project.

3. Parametric variable analysis of the UK LTS system, which enables understanding and demonstration of the applicability of the R&D programme to the whole UK LTS network.

4. Value For Money analysis to investigate whether the developed repurposing strategy will provide 'best' value for the whole system.

5. Material severity investigation to ensure blueprint covers all assets.

6. Land referencing map for 100% hydrogen Grangemouth to Granton pipeline.

Of the six objectives listed, 2-6 are now complete and fed into either the NZASP approval process or the LTS Futures project. The scope associated with objective 1 has been updated as the project developed. An optioneering study has been completed but two supporting activities to this objective are not yet complete.

Firstly, creation of project specific versions of SGN welding procedures, P/2 and W/8 are currently under way and due for completion in

summer 2023. Secondly, during delivery of NIA2\_SGN0012 – Recommissioning Grangemouth to Granton, it was decided that the most appropriate time to develop the commissioning, operation, and decommissioning procedures for the live trial, originally planned to be completed as part of the optioneering study, is alongside the detailed design process for the live trial. Now the completion date for this project is planned for September 2024, once the live trial is under way.

## Recommissioning Grangemouth to Granton (NIA2\_SGN0012)

Supporting consumers  
in vulnerable situations



Net zero and the energy  
system transition



Whole energy  
systems



Data and  
digitalisation



Flexibility and  
market evolution



Optimised assets  
and practices



This project is a pre-feed for the LTS Futures project to allow the LTS Futures project timeline to be maintained while the project itself progressed through the NZASP approval process. The main outputs of the project are:

1. A recommissioning feasibility study for the Grangemouth to Granton pipeline identifying specific requirements and constraints of the pipeline to produce a strategy for carrying out the In Line Inspection (ILI).

2. A feasibility study in uprating of LTS pipelines for distribution of 100% hydrogen.

3. Completion of above ground surveys of the Grangemouth to Granton pipeline to assess integrity of the pipeline and potential to repurpose the pipeline to hydrogen.

The project was delayed by approximately six months due to bird nesting and crop season, and their impact on the scrub clearance required before all the surveys could be completed for the entire length of the pipeline.

The feasibility study to explore the options for how the Grangemouth to Granton pipeline can be internally inspected has been completed and it has been demonstrated that technically and economically viable options for undertaking the inspection exist.

The uprating feasibility study has been completed and demonstrated that there is potential for uprating the LTS pipelines across the regulated networks in Great Britain. This will be expanded upon within the LTS Futures project. All the planned surveys have been completed and the results fed into the LTS Futures project.

# Hydrogen Village Trial Hydrogen Appliance Supply Chain (NIA2\_SGN0026)

Supporting consumers in vulnerable situations



Net zero and the energy system transition



Whole energy systems



Data and digitalisation



Flexibility and market evolution



Optimised assets and practices



Hydrogen can provide a decarbonised energy source for heat, transport, industry, and power generation. However, there is limited knowledge and documentation regarding the availability and readiness of hydrogen-compatible appliances in the UK market. In light of this, SGN was tasked by DESNZ and Ofgem to assess the supply chain of hydrogen appliances as part of the Hydrogen Village Trial (HVT), focusing on network compatibility. The assessment aimed to cover both domestic and light commercial appliances, provide insights on end-user requirements in a hydrogen-powered future, and assist gas distribution networks in meeting this demand.

Furthermore, in addition to assessing the availability and requirements of appliances for the HVT, the project aimed to prepare development strategies for each product platform. Additionally, a procurement strategy was to be devised to advance the maturity of the appliance catalogue. This strategy involved a combination of industry expertise, desk-based research, direct engagement with appliance and component manufacturers, and collaboration with trade bodies. Its purpose was to continue the development of prototype and proof-of-concept appliances from the Hy4Heat program, as well as address appliance types that were yet to be developed.

The objectives and benefits of this project were to:

- Conduct a supply chain analysis
- Assess Appliance Reliability
- Prepare a Hydrogen Alternative Report
- Develop a Development Strategy
- Establish a Procurement Strategy

During the project, a thorough assessment of the hydrogen appliance supply chain market was conducted for the HVT. This assessment involved evaluating the availability, reliability, and gaps in developed hydrogen appliances, equipment, and materials. The outputs concluded that the development requirements for domestic and non-domestic portfolios were extensive and diverse.

Considering the unavailability of certain appliances and other concerns, it was acknowledged that not all properties and appliances would be converted to hydrogen. Some properties would opt-out of the trial and require conversion to an electric heat source. In response, a 'hydrogen alternative' portfolio was developed and submitted to DESNZ. This portfolio outlined a variety of appliance types that utilise alternative heat sources for the current natural gas appliances installed. It provided information on the methods and technologies available for customers who preferred non-hydrogen heat sources.



Additionally, the project delivered a Development Strategy, focusing on appliances surveyed in the trial areas that required further development or needed to be developed from scratch. This strategy included a breakdown of research and development costs for each appliance type and Original Equipment Manufacturers (OEM).

Furthermore, a Procurement Strategy was delivered, developed in collaboration with Arup. This strategy utilised industry expertise, research, and direct engagement with appliance manufacturers and trade bodies to identify available consumer solutions and understand heating technology preferences. The Procurement Strategy outlined contractual obligations, purchaser/supplier relationships, and key commercial details such as warranties, guarantees, and pricing options.

To support the initiation of a full Appliance Development Programme, a subsequent 'Business Case' activity was undertaken beyond Stage 2. Led by the Appliance Working Group (AWG) with continued support from Arup, a formal business case is being submitted to DESNZ in May 2023, justifying the need for a funding pot of approximately £12.6 million. If approved, this program would oversee the development of all appliances necessary for the HVT, particularly those not yet self-funded by OEMs since the closure of Hy4Heat.

# Hydrogen Appliance Supply Chain - Technical Specification & Development Strategy (NIA2\_SGN0037)

Supporting consumers in vulnerable situations



Net zero and the energy system transition



Whole energy systems



Data and digitalisation



Flexibility and market evolution



Optimised assets and practices



The successful progress of the H100 Fife Neighbourhood and HVT relies on the availability of hydrogen appliances. To facilitate the availability of suitable appliances for the trial, it is necessary to understand the technical specifications required for hydrogen appliances, establish benchmarks for each type of appliance, and ensure that the appliances are safe, reliable, easy to use, aesthetically pleasing, fully certified, and of suitable quality while being cost-effective.

This project aims to provide detailed Technical Specifications for the development of hydrogen fires and cookers that are ready and certified for use in the hydrogen trials. It also seeks to create a Development Strategy and a H100 Appliance Supply Chain report for these appliances, which will help address the issue of unavailability of suitable fires and cookers in the hydrogen trials.

The Technical Specification report, delivered by Enertek, serves as a comprehensive guideline for GDNs to assess the suitability of new hydrogen appliances for various trials. The evaluation criteria cover aspects such as product safety, reliability, aesthetics, ease of use, certification, and quality.

Furthermore, the Development Strategy for domestic fires and cookers, currently under review, aims to identify the necessary resources for manufacturers and propose a process for developing appliances that meet the Technical Specifications in a timely and cost-effective manner. The final version of this strategy, expected to be delivered by Enertek later in 2023, will provide in-depth detail on the development process.

Additionally, the H100 Appliance Supply Chain strategy, being prepared by Arup, will define the roles of various OEMs and will propose a strategy for creating a comprehensive appliance catalogue suitable for the trials. The strategy will consider both hydrogen-capable appliances and electrical alternatives, depending on the feasibility and cost-effectiveness of procuring hydrogen equivalents by September 2024.

The Technical Specification document, being delivered by Enertek, provides a benchmark for assessing the suitability of appliances before their inclusion in any hydrogen trial. It includes a product suitability checklist that allows recording the assessment results of different criteria such as performance, safety, certification, and reliability. This document serves as a risk assessment and due diligence activity to ensure the protection of end-users, trial owners, and manufacturers. It also provides a framework for providing feedback to manufacturers who fail to meet the requirements and are therefore rejected for use in the trials.



The Development Strategy, in its first draft stage, is being submitted by Enertek in May 2023 and is currently under review. The H100 Appliance Supply Chain strategy, prepared by Arup, is currently under way and expected to be delivered later in 2023. This strategy will provide a plan for either acquiring hydrogen-capable appliances or exploring electrical alternatives to meet the requirements of the trials.

The project is still ongoing, with the completion of the Development Strategy and H100 Appliance Supply Chain strategy expected in the near future.

# High Volume Gas Escapes Tool - update for hydrogen (NIA2\_SGN0034)

Supporting consumers in vulnerable situations

Net zero and the energy system transition

Whole energy systems

Data and digitalisation

Flexibility and market evolution

Optimised assets and practices

A key element in the pathway toward the decarbonisation of the UK is to ensure a safe transition of the network from natural gas to hydrogen. A fundamental commitment for SGN is to ensure the safety of consumers and our operatives engaged in the construction, operation, maintenance, and repair of the network. Making sure our pipes deliver gas safely and reliably means that we need to repair them at times. The process of high-volume gas escapes is understood, with safe control of operations and procedures in place to carry out this process safely on networks across the UK.

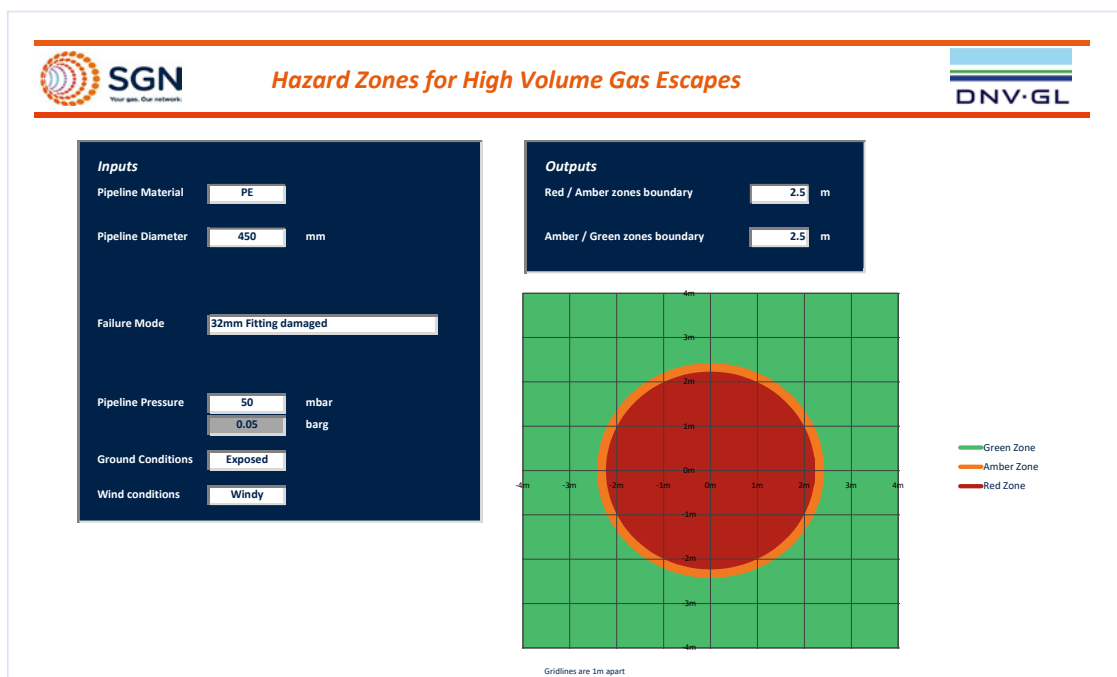
SGN responded to uncontrolled and controlled gas escapes each year to which our engineers respond to the high-volume gas escapes with suitable emergency response procedures and tools. The High Volume Gas Escapes Tool (HVGET) is one of them. This technology was developed to predict indicative hazard distances associated with gas escapes from distribution pipelines based on operating parameters, atmospheric conditions and features of relatively rich natural gas streams. The tool displays a virtual map showing graphically three indicative ignition zones to help our engineers safely plan their work and avoid damage while carrying out a range of work according to the established procedures.

The switch to hydrogen will require a review of the end-to-end processes, including tools and procedures used to characterise and control gas escapes ensuring that current practices used for natural gas are fit for purpose with 100% hydrogen.

This commission aims to improve the mathematical model used in the HVGET to make it suitable for hydrogen. Likewise, the new model will expand the understanding of below-ground releases.

The outputs of the project may subsequently be used to upgrade the HVGET to allow users to select hydrogen as an input parameter. The new tool will be capable of delivering accurate information to effectively understand the dynamics of hydrogen escapes and, as a result, it will support our gas operatives to make the workspace safer, reduce the response time, and securely stop gas loss while allowing SGN to ensure the continuity of procedures and practices of emergency response in the event of gas escapes.

The development of the improved mathematical model is currently under process and the outputs will be included in the final report. The project is scheduled to be completed by end-June 2023 along with all deliverables according to the success criteria.



# Ignition Probability in Small Services (NIA2\_SGN0027)

Supporting consumers  
in vulnerable situations

Net zero and the energy  
system transition

Whole energy  
systems

Data and  
digitalisation

Flexibility and  
market evolution

Optimised assets  
and practices

To achieve the UK Government's net zero policy by 2050 (with the Scottish Government targeting 2045), hydrogen is considered a key low carbon alternative to natural gas. Hydrogen can provide a decarbonised energy source for heat, transport, industry, and power generation. In order to be deployed, evidence must first be gathered on the relative risks between hydrogen and natural gas.

The Hydrogen Ignition Probability was set up to address a gap noted in the DESNZ End User Evidence Framework (EUEF). This framework identifies several evidence gaps relating to end-user safety that require fulfilment prior to the use of 100% hydrogen in the GB gas network.

SGN contracted Steer Energy (in collaboration with Astrimar Ltd.) to perform this work.

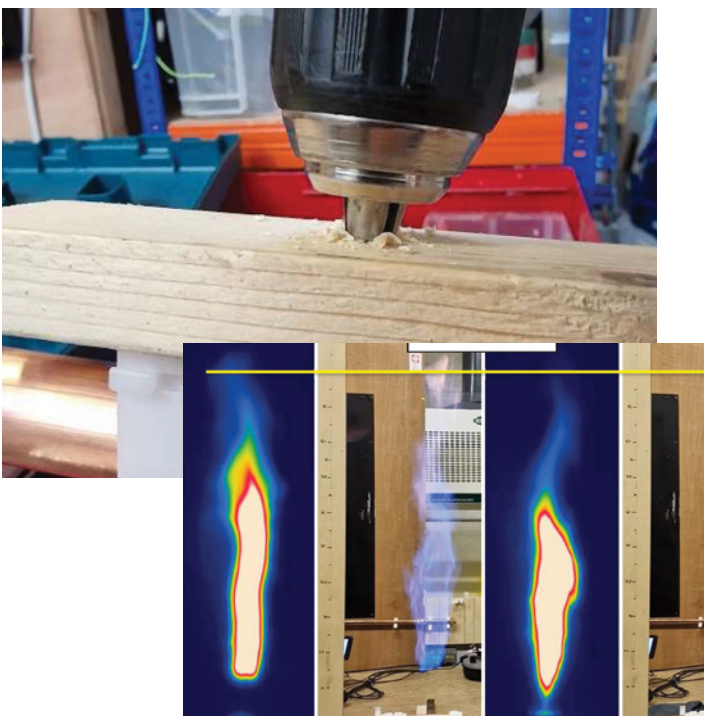
The Ignition Probabilities in Buildings Associated with Small Services project aims to investigate some of the risks associated with the conversion of the UK gas supply from natural gas to hydrogen. It aims to assess the ignition characteristics of natural gas and hydrogen especially during, and immediately after, leakage is caused in downstream gas pipework. Events to be addressed included accidental damage from DIY activities and construction work, and collisions with and impacts to pipes and fittings. The scope was defined by a person being present (to create the leak), and ignition being immediate or within a short timeframe.

This project aimed to carry out short-term, near-field investigations rather than longer term gas accumulation studies. The experimental work fed into a probability analysis with the aim of providing a comparative safety assessment of the risks associated with damage to installations containing hydrogen and those containing natural gas.

The project covered domestic installations up to 67kW and small commercial installations up to 100kW.

The outcomes from this project are summarised below:

- Gas leak ignition is very rare.
- Ignition of a significant leak is not necessarily the most hazardous outcome, as this prevents accumulation and subsequent risk of explosion.
- The resulting flames are similar in size and consequence.
- Natural gas and hydrogen plumes from leaks in free space reach non-ignitable concentrations within a metre.
- Constrained leaks of either gas into poorly ventilated spaces can quickly build into an explosive mixture.
- Excess Flow Valves (EFVs) can effectively mitigate against large leaks, which are more likely to lead to explosive accumulations. They should be set as low as possible above the flow requirements of the installation.



# Interventions for Hydrogen by Asset Group (NIA2\_SGN0025)

Supporting consumers in vulnerable situations



Net zero and the energy system transition



Whole energy systems



Data and digitalisation



Flexibility and market evolution



Optimised assets and practices



To inform the Heat Policy Decision (HPD) of 2026, which will decide the future of the GB gas distribution network, the GDNs have produced a whole body of evidence on the suitability of the network in transporting hydrogen. The Interventions for Hydrogen by Asset group project is developing a framework to manage this evidence.

Based on the Network Safety and Impacts (NSI) framework, the project is building a database of all network assets and components, split into pressure tiers, themes, and categories. All information, evidence, and data on hydrogen generated from network projects are then gathered and recorded into this live database.

By creating a centralised system, networks will be able to easily identify potential outstanding knowledge gaps and determine interventions to close these gaps, to better demonstrate the suitability of the gas network for hydrogen

conversion. The database will provide a central repository for previous, ongoing, and future research projects which will bring visibility to the status of the research work, by identifying expected completion dates, red-amber-green (RAG) categorisation, and key priority areas for R&D.

On top of creating a useful tool to evaluate the current body of evidence on hydrogen, this database will also help avoid duplication in projects, as well as assist in scoping new projects. Importantly, the database will help align the evidence process with the HSE Evidence Review Groups (ERG) review process.

This will become the basis for future iterations of the database, improving the evidence and reducing identified gaps with every phase. The database will undergo another three iterations until December 2023. This is a valuable tool for all networks working towards the HPD.

LOW PRESSURE (≤ 75 mbar)

- Add in detail of the safety evidence each project has demonstrated (e.g. what was tested)
- Leave cells blank where no evidence exists
- Other instructions in blue text
- Text in red if project is in planning stage

Rating (1-5) {TBA = To Be Assessed}

NF Not feasible

1 No research undertaken, many key knowledge gaps

2 Limited research undertaken, many key knowledge gaps remain

3 Some research undertaken, several remaining knowledge gaps

4 Significant research undertaken, few knowledge gaps remain

5 Fundamentally all research has been completed

Add additional sub-categories or additional rows where required

Evidence Gaps

Yes No	Ref	Theme			Category 1
Yes	1.3.1.1	1. Materials	PE distribution mains	New PE	Distribution mains
Yes	1.3.1.2	1. Materials	PE distribution mains	Old PE	Distribution mains
Yes	1.3.2	1. Materials	Cast iron		Distribution mains

Rating (1-5)	TRL (1-9)	CRL (1-6)	Recommended Intervention to close the gap(s)	HSE Consideration	
5	TRL 9	CRL 6	For modern grades of PE - no interventions required to close gaps.	For Policy (D1-D65)	For Trials (T1-T63)
2	TRL 4	CRL 1		D10, D11, D13, D20	T5, T8, T9
3	TRL 5	CRL 1	Wait for the results of the existing trials in progress (HyDeploy & another 100% trial - using results of HyDeploy and reanalysing data for 100%.	D10, D11, D17, D19, D20	T5, T8, T9, T13

# Retrofit Excess Flow Valves (NIA2\_SGN0019)

Supporting consumers in vulnerable situations

Net zero and the energy system transition

Whole energy systems

Data and digitalisation

Flexibility and market evolution

Optimised assets and practices

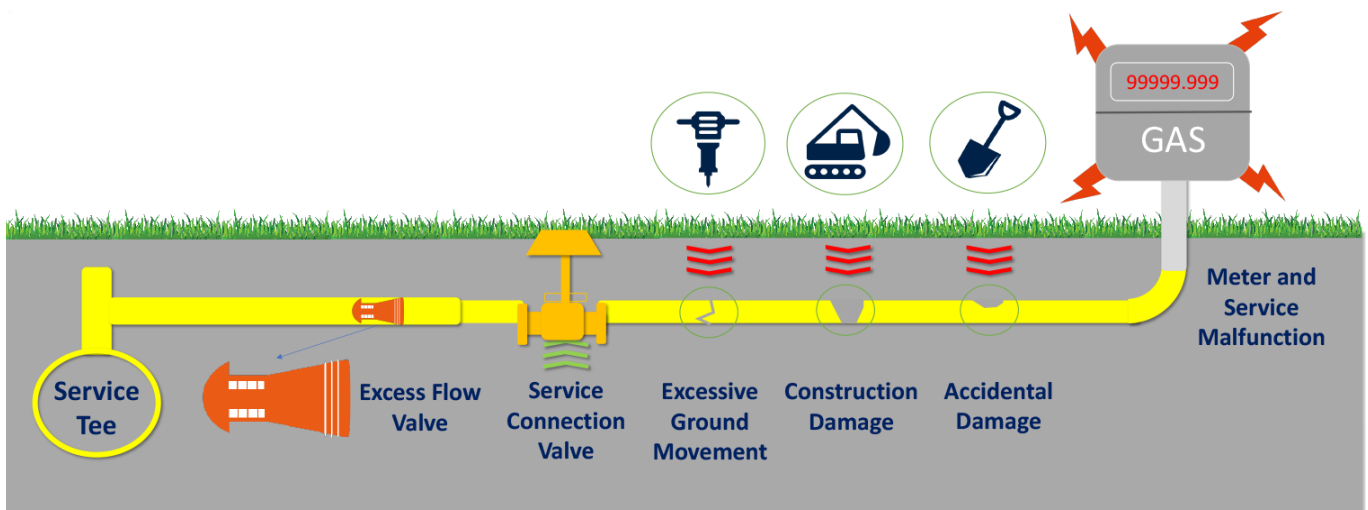
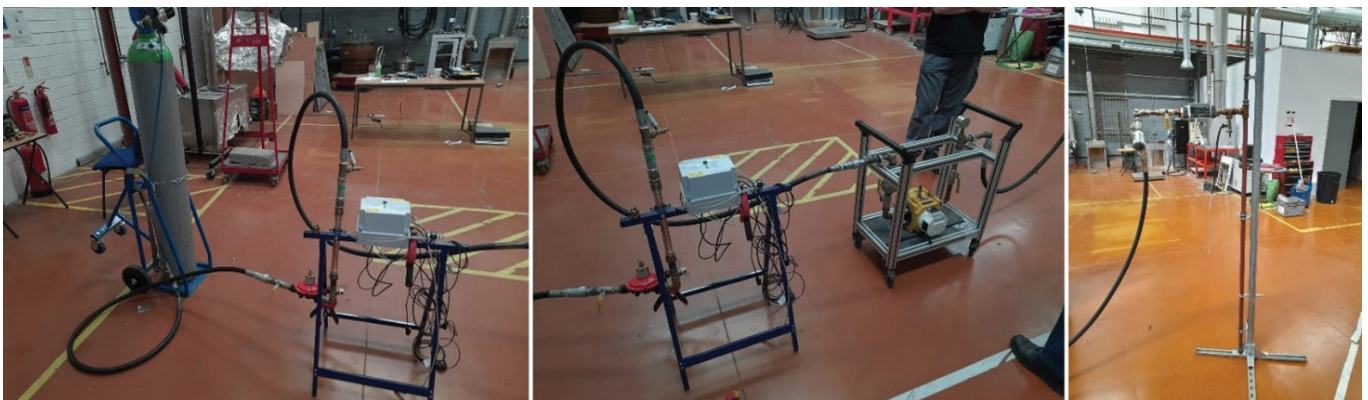
A key element of the transition to hydrogen is to deliver compelling evidence for the enduring use of existing gas network assets in the form of a pathway to decarbonisation. Safe operation is of paramount importance when transitioning from existing natural gas to hydrogen. Excess Flow Valves (EFVs) are a current safety feature for new medium pressure natural gas services and could become vital in future low pressure hydrogen services. For this reason, EFVs constitute a key aspect of the safety case for the H100 Fife Neighbourhood trial.

This project aims to demonstrate the reliability of EFVs in low pressure hydrogen services and to review methods for retrofitting into existing services during a potential wider rollout.

This project builds on important learning to date from SGN's previous study, hydrogen excess flow valves (NIA\_SGN0154), and is developing a new device compatible with hydrogen gas flow rates within the service. A number of commercially-

available EFV models have been lab tested in this project to measure their actual trip flow rate to ensure they repeatedly and reliably meet the project requirements. A prototype EFV suitable for use in a 32mm Polyethylene (PE) service is also being developed for use within the H100 Fife trial.

Fitting new hydrogen EFVs into existing services at the service connection from the main would involve open cut techniques and would therefore be considered an unviable solution for large scale conversion. The project will identify and resolve any potential issues associated with the installation of EFVs in low pressure hydrogen distribution networks by looking at existing techniques and tools to potentially retrofit EFVs into existing natural gas services as part of the network conversion process. The project will start with a Technology Readiness Level (TRL) of 2 and end with a TRL of 9 for new PE EFVs for use with the H100 Fife trial.



# Northeast Scotland pre-FEED (NIA2\_SGN0007)

Supporting consumers  
in vulnerable situations



Net zero and the energy  
system transition



Whole energy  
systems



Data and  
digitalisation



Flexibility and  
market evolution



Optimised assets  
and practices



To promote and stimulate a growth in the hydrogen economy, SGN developed the Aberdeen Vision project that was aimed at targeting the conversion of Aberdeen City and Aberdeenshire through the installation of a dedicated hydrogen pipeline from St Fergus to Aberdeen to link areas of hydrogen production with key network locations to decarbonise large areas of Scotland. The project involved facilitation of blue hydrogen production at St Fergus combined with future green hydrogen production from offshore wind.

The objectives of the Northeast Scotland pre-FEED project were to increase the level of confidence in both technical feasibility and cost certainty that could then be used to secure the next FEED stage of funding under Ofgem's Net Zero Pre-Construction and Net Zero Reopener funding mechanisms.

The above-7 bar transmission system solution was developed by WOOD and the below-7 bar networks by DNV. The final project report is expected to be completed in July 2023.

## Above-7 bar Transmission Solution

The above-7 bar transmission system, focused on the installation of a dedicated hydrogen pipeline from St Fergus to Aberdeen where the key outputs from the project included a proposed FEED Scope of works supported by 34 additional documents that covered key elements listed below:

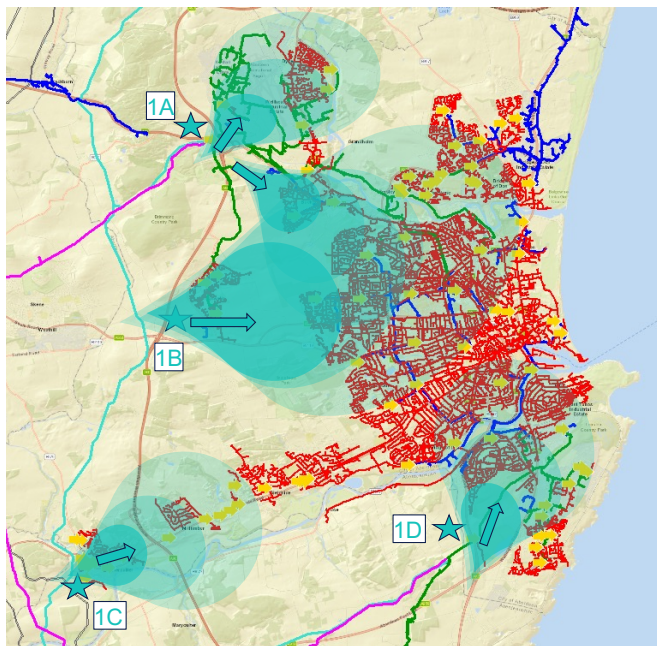
- Pipeline Routing
- Flow Assurance
- Material Selection/Mechanical Design
- Consenting and Environmental Requirements
- General Arrangement Drawings
- Electrical/Instrumentation Designs
- Safety/Risk and Assessments
- Schedule/Costing

The project identified a feasible route for a dedicated 36" x 75km Hydrogen Pipeline from St Fergus to a point south of Aberdeen with initially five rising to eight locations where hydrogen would be connected to existing downstream distribution points.

An estimate of the total FEED costs, based on the proposed scope of works was delivered by the project. This includes geotechnical, topographical and utility survey works for the major crossings along with a 20% contingency.

The above-7 bar Pre-FEED study has provided a clear basis for FEED execution. Illustrating preferred development of pipeline routing, required pipeline facilities to support regional conversion and also included characteristics that would enable further expansion of the hydrogen system south of Aberdeenshire and connection to future phases, namely SGN's Caledonia pre-FEED Project.





### Below-7 bar Solution

The aim of this part of the study was to demonstrate the viability of converting the gas network in the Aberdeen area to 100% hydrogen using the new upstream hydrogen PRS sources proposed by the above-7 bar solution to deliver hydrogen from the Acorn project (based at St Fergus) and green hydrogen from the offshore Dolphyn project.

The objective of the pre-FEED was to increase the level of confidence in the technical feasibility and cost certainty to support delivery of the below-7 bar FEED study.

**Phase 1** – Developed appropriate project assumptions to enable the delivery of a high level network conversion strategy that included a review of the hydrogen supply and conversion philosophy based on the potential sources of hydrogen provided by the above-7 bar study.

**Phase 2** – Examined the demand demographics and pipeline parameters to develop statistically representative areas, whereby six domestic areas and two predominantly I&C areas were identified that could then be used to scale up against the overall network.

Analysis was undertaken to determine the operating window for conversion activities by examining the annual demand profiles. This resulted in a 21-week window (mid-May to early October) being recommended as a practical approach that would be used to feed into the overall conversion planning and execution schedule.

**Phase 3** – Involved carrying out a detailed assessment to develop the costing for the project and the FEED.

Models were created that represented the state of the pipe network at a time in the future when hydrogen could be injected into the system. These representative areas were then used to develop a sector-by-sector conversion plan and provided sector diagrams with summary tables that listed all the asset change requirements e.g. valves, governors, purge points, reinforcement and hydrogen pipe safe replacement.

The conversion masterplan strategy was then developed that provided the “Roadmap to Conversion”. This focused on all technical aspects and described all the activities that would need to take place over a timeline counting backwards from the conversion of the first property. The roadmap was then used to determine the skill type and total number of operatives required to complete all activities.

**Phase 4** – Carried out an assessment to determine the estimated costs for the below-7 bar network. DNV used the roadmap activities to provide a complete breakdown, that included estimated costs per domestic, commercial and industrial user. Costs from both above and below-7 bar pre-feed studies were then merged to provide the total FEED cost for the whole of the Northeast Scotland FEED project.

### Areas Of Uncertainties & Recommendations

Several areas of uncertainty relating to the network analysis and the costing were reported by the project along with a number of recommendations that will need further review to provide further clarification on the base assumptions and support any fundamental decisions that underpin the overall conversion masterplans for both Aberdeen and other natural gas to hydrogen conversion projects.

An SGN workshop is planned to present the findings to discuss the findings and route forward.

# Industrial & Commercial Plant Hydrogen Sensitivity Assessment (NIA2\_SGN0006)

Supporting consumers in vulnerable situations



Net zero and the energy system transition



Whole energy systems



Data and digitalisation



Flexibility and market evolution



Optimised assets and practices



The study aimed to provide an overview for the range, type, numbers, and applications of Industrial and Commercial (I&C) installations and assess the potential future decarbonisation and hydrogen utilisation. Aberdeenshire was selected for the focus area to later support the ongoing Aberdeen Vision project looking at the conversion of the downstream networks.

Objectives were to provide a logical and repeatable methodology that can be applied across the UK to assess the impact of hydrogen on users and to develop an initial baseline database of plant types/makes/models for conversion. The I&C hydrogen potential factors are demonstrated within the image below:

- Market sectors and equipment types
- Location of installation
- Technical suitability and challenges
- Sensitivity of hydrogen
- Conversion or retrofit

Engagement with manufacturers demonstrated confidence for operation on hydrogen, however gaps were identified by I&C stakeholders surrounding the high cost for demonstration projects and the availability of test facilities for commercial and small industrial equipment.

An RAG system was developed to map equipment to potential hydrogen solutions. As the majority of installations were associated with space/water heating, and such technologies are already available for hydrogen utilisation, the

overall situation for conversion is very positive with an estimate that over 80% of installations could be readily converted.

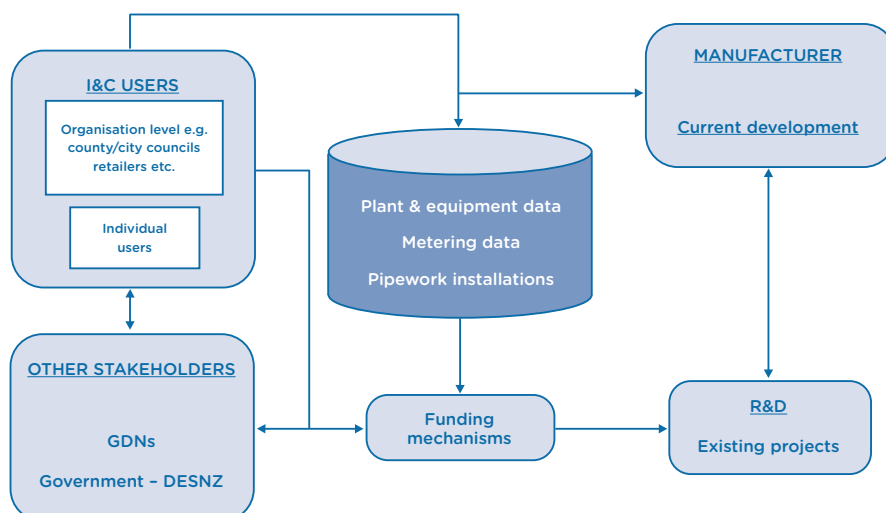
Outcomes for the project resulted in a basic understanding of I&C applications and their readiness for hydrogen, however the data set was considered incomplete due to challenges around stakeholder engagement necessary to deliver detailed knowledge of all installations.

Several options for future engagement were developed during the project that will be taken forward into future stakeholder engagement projects.

The key recommendation is the development of a new roadmap or “blueprint” (shown at the bottom of this page) to plan, collate, coordinate, control and distribute information to all the relevant stakeholders. This includes establishing a complete set of data requirements for informative decision making that could be rolled out across the UK.

Next steps are to discuss and develop the national stakeholder engagement strategy and database system for users, manufacturers, Government departments (DESNZ, Department for Environment Food and Rural Affairs (DEFRA) and others). Current options being considered:

- Transfer findings from the project and develop a scope that can be embedded into the planned Hydrogen Town Pilot projects.
- Engage with all GDNs to set up a collaborative phase 2 project on a significantly sized area/region.



## Street Score 2 (NIA\_NGN\_338)

Supporting consumers  
in vulnerable situations



Net zero and the energy  
system transition



Whole energy  
systems



Data and  
digitalisation



Flexibility and  
market evolution



Optimised assets  
and practices



The public, including those on the Priority Services Register, often find journeys through and around street works a challenge. When travelling through street works, there is an inevitable level of inconvenience caused by the works. However, the public's tolerance and, potentially, safety levels diminish if there are avoidable obstructions or if signage is unclear.

The StreetScore project looked to investigate processes, products, and technologies that could be used by the GDNs/DNOs to improve the journeys of individuals through the street works and prevent people from being put into vulnerable situations.

This work was carried out by Steer Energy, supported by Transport for All.

During Phase 1 of the project, a clear understanding was achieved of the challenges and the situations that could occur due to street works that would put the public in potentially vulnerable situations or add to the challenges they face on a daily basis.

Phase 2 sought to collaborate with a “customer user group” of disabled individuals, carers, and advocacy groups to develop a range of concepts and processes.

Key to the success of this project was the collation of a disabled-led workgroup supported by Transport for All. This group provided key input to the design, testing and validation of the concepts. Likewise, with the support of the project sponsor, Steer worked to understand how these concepts

could be adopted into the field by consulting operatives and streetworks professionals.

The project delivered the following:

- A set of principles aimed at doing better, which are represented in a pilot training module and complimentary handbook
- A range of improvements that can be realised in the short term via a series of field trials and validation exercises
- A series of medium-term improvements requiring additional development
- Increased engagement from project sponsors in this area.

Several Stage 3 proposals are in development to enable the solutions highlighted to be field tested and developed further as needed. These include:

- Live Field Testing of Stage 2 concepts
- Development of a boardwalk replacing the need for ramps
- Developing an App based communications system.

A key next step is to further engage with senior leadership within the project sponsors to ensure that corporate commitment can be leveraged to ensure that this project delivers the technical, behavioural, and organisational change required.



# Orbital Eye (NIA2\_SGN00035)

Supporting consumers  
in vulnerable situations



Net zero and the energy  
system transition



Whole energy  
systems



Data and  
digitalisation



Flexibility and  
market evolution



Optimised assets  
and practices



The UK's pipeline infrastructure is an integral part of the energy distribution system, and its maintenance and surveillance are vital to prevent potential threats and disruptions. Traditionally, we relied on helicopter flyovers to monitor the integrity of our pipeline network. This method, while effective to some degree, was costly, environmentally impactful, and offered limited frequency and precision.

The main issues addressed by the project were the inconsistencies in the timing of reports generated, its high environmental impact, and the relative inefficiency in identifying and reporting Third Party Interferences (TPIs) which could lead to a major disruption for the gas network serving millions across the UK and on which our vulnerable community are especially reliant. A solution was sought that could offer more accurate and frequent monitoring, and that could significantly reduce our carbon footprint.

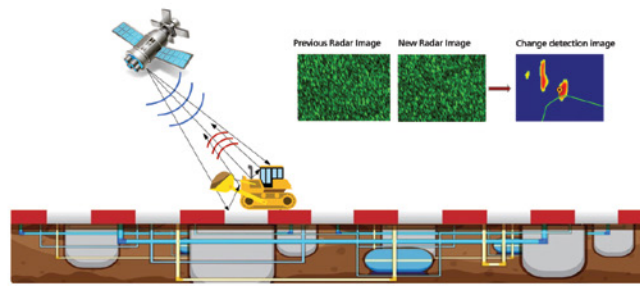
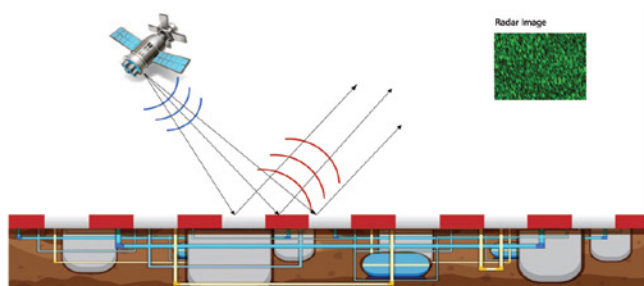
The project aimed to implement the CoSMiC-EYE technology from Orbital Eye for our pipeline monitoring, providing frequent, high-quality, and consistent reporting of potential TPIs, with minimal environmental impact. The technology uses Synthetic Aperture Radar (SAR) and multispectral (optical) satellites, coupled with AI-assisted processing, to generate precise and comprehensive change maps. The regimental weekly reporting time allowed us to plan our work proactively and prioritise tasks effectively and more often with scope to improve this at a business need. The project's environmental benefits have also been significant, with the technology producing zero CO2 emissions each week.

As Phase 1 of the project concludes, we are able to report significant enhancements in our monitoring capabilities. The integration of CoSMiC-EYE technology has led to a noticeable increase in the detection of Third Party Interferences (TPIs) and the standardisation of our reporting times, contributing to a more efficient workflow. Furthermore, the environmental impact of our monitoring operations has been significantly reduced, with the CoSMiC-EYE system registering zero CO2 emissions each week.

This outcome aligns well with our sustainability goals and highlights the potential of advanced technology in reducing the carbon footprint of pipeline monitoring. The insights gleaned from this initial phase have been valuable in recognising the potential of CoSMiC-EYE and in identifying further areas of inquiry.

Feedback from our engineers and administrative staff, in addition to the data collected in the field, will be vital for an in-depth analysis of the practical benefits of this system.

Phase 1 results are encouraging and signal a promising direction for enhancing our operational efficiency, safety, and sustainability. The findings and observations gathered will be instrumental for our future decisions on the potential full-scale adoption of this technology.



Classical- and AI-based filtering of irrelevant changes

# TapSOS - Digitalisation of the emergency number

## - Phase 1 (NIA2\_SGN0031)

Supporting consumers in vulnerable situations



Net zero and the energy system transition



Whole energy systems



Data and digitalisation



Flexibility and market evolution



Optimised assets and practices



As part of our ongoing commitment to innovation and inclusivity, SGN has partnered with Inclutech, aiming to transform the National Gas Emergency Service numbers into a digital platform. The partnership arose from the recognised need to make communication with gas networks more accessible, particularly for vulnerable consumers who may encounter barriers in understanding or communicating their needs.

Traditional communication channels with gas networks have been challenging for numerous customers, leading to unnecessary calls, difficult triage, slow response times, and potential inaccuracies in information handling. These issues were especially prevalent among vulnerable individuals who are non-English speakers or those with conditions such as deafness or autism. These challenges are not only causing stress for the consumer, but also result in overspending for the provider.

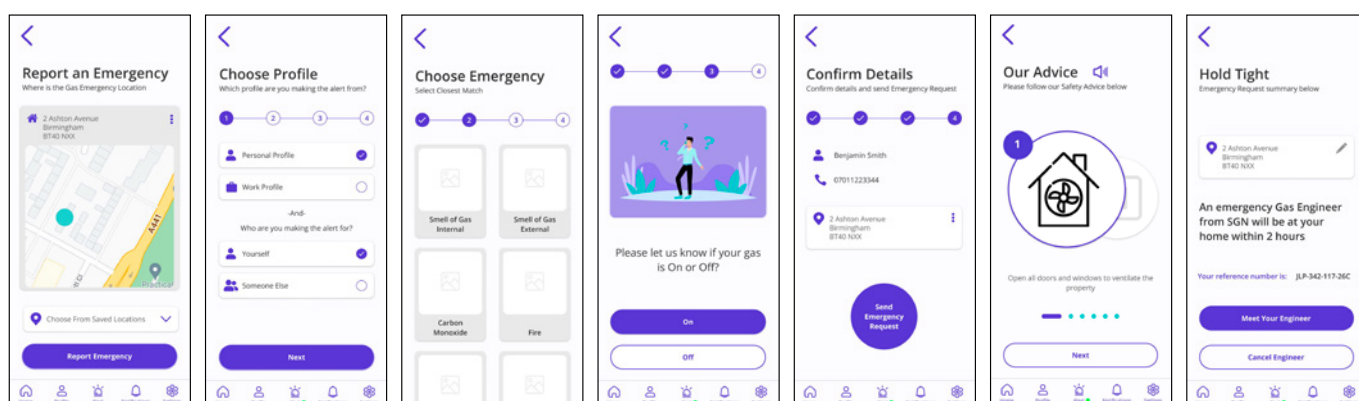
The main objective of Phase 1 was to conduct a feasibility study, design thinking, software specification planning, research sessions, and design software specifications for the digital platform. The benefits of this project, once completed, will be far-reaching. It will lead to a reduction in the number of unnecessary calls, improved response times, better triage, and more accurate information handling.

It will ensure more inclusive communication channels, enabling even the most vulnerable consumers to communicate efficiently and effectively with the gas networks.

Phase 1 was successfully completed with all the deliverables achieved. Key activities included initiating the project, developing wireframes, and securing sign-off from SGN to proceed. One challenge encountered was gaining access to National Grids operations control centre for IT architecture, which will be addressed in Phase 2.

Moving into Phase 2, the project will now progress towards software development, graphical design, and further feedback incorporation. A midway review with SGN is planned, along with dashboard development and technology demo preparations.

The support of additional stakeholders, including Cadent, Northern Gas, and Wales and West Utilities, will be welcomed for the next phases. This innovative project is expected to set new standards for communication within the gas network industry, bringing about greater efficiency, inclusivity, and satisfaction for both providers and consumers.



# H100 Fife 'Hydrogen Neighbourhood'

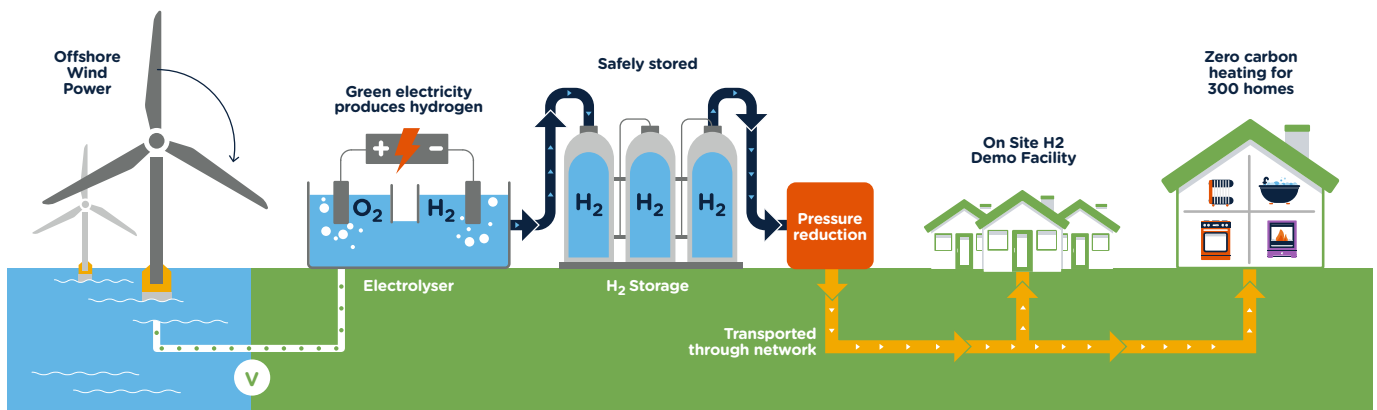
H100 Fife is seeking to deliver a 'first of a kind' demonstration of a 100% hydrogen network that aims to supply 300 customers in Fife.

## Overview

In a move to decarbonising the gas networks, in line with government net zero targets, hydrogen could offer a credible alternative to natural gas without any environmental impact. The H100 Fife project will comprise of an end-to-end system, including power generation, hydrogen production, storage, pressure reduction, odorisation, distribution and customer connections to serve domestic hydrogen meters and appliances. The H100 Fife site is situated at Fife Energy Park and the primary power input for the system will be supplied by an existing 7MW offshore wind turbine located on the coast in Levenmouth

adjacent to the site. H100 Fife will construct a new PE hydrogen network to run in parallel to the existing natural gas network which will serve the adjacent residential area. This parallel network enables us to promote and maintain customer choice, in order to gain critical information on customer attitudes and interest towards hydrogen, providing evidence on public acceptance of hydrogen for domestic heat.

The project seeks to deliver priority evidence for the future role of the gas distribution network in facilitating net zero in accordance with the UK Government 10-point plan and Scottish Government Hydrogen Policy.



## Progress

We have achieved great successes which have allowed the project to progress across the various workstreams:

### Upstream - Hydrogen Production & Storage

The project has transitioned from the development stage to the construction phase as works commenced on site in relation to the hydrogen demonstration facility and we successfully appointed Altrad Babcock as our Main Works Contractor in January 2023. Altrad Babcock is responsible for the construction and completion of the H100 Fife site.



The H100 Fife site is planned for completion in the second half of 2024. DNV were contracted to deliver the hydrogen demonstration facility and appointed Marshall Construction in September 2022 as the contractor to build and complete the hydrogen demonstration facility. Marshall Construction has started construction on site and are on schedule to complete the build by September 2023. We also appointed Wefco Ltd to fabricate and deliver six hydrogen storage tanks, key components of the project's security of supply philosophy. The electrolyser contract was signed with NEL in September 2021. We have received shipments of the electrolyser equipment at our storage location opposite the site.



## Midstream – Hydrogen Distribution Network

In January 2023 we appointed SMART Utilities to build and commission the distribution network. Construction commenced in May 2023 and is due for completion in June 2024. The construction is to be completed in the following phases.



## Downstream – Customer Marketing & In-home Works

We have obtained over 270 registrations to the project, which is an Ofgem funding condition of minimum participant numbers. We currently have 367 (as of June 23) project registrations.

This was achieved by successfully planning and hosting strategic activities and events including Recruitment Events in October 2022, which allowed the local community to engage with members of the H100 Fife team. We received overwhelmingly positive support at the event.

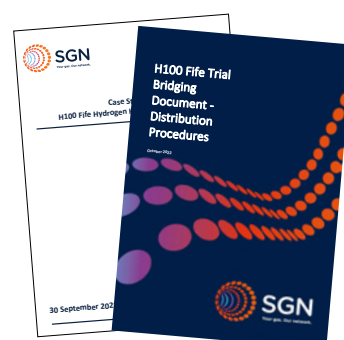
The consumer engagement has been considerable and has resulted in a close relationship with the local community which continues to grow via activities such as sponsoring local events and engaging with key local stakeholders.



## Overarching Workstream

We obtained notification from Ofgem in relation to our safety related Ofgem funding condition, Condition 5- 'no showstoppers' in March 2023. DNV is in contract to deliver the Cases for Safety documents and we submitted a suite of documents to the HSE in December 2022 for review.

From a regulatory perspective the project passed key milestones with acceptance of the Uniform Network Code modification 0799 and the implementation H100 Fife Xoserve multiplication factor.



The Local Transmission System (LTS) Futures Project forms part of the UK's national hydrogen research programme to deliver a Net Zero decarbonisation solution for customers. The project seeks to research, develop, test and evidence the compatibility of the LTS assets, pipelines, associated plant and ancillary fittings, culminating in a 'first of a kind' repurposing trial and demonstration.

The aim of the project is to demonstrate that the LTS can be repurposed and potentially uprated to convey hydrogen, providing options for the decarbonisation of power, industry, heat and transport by delivering a safe supply of energy to all customers both during, and after the energy transition.

This project intends to repurpose the Grangemouth to Granton pipeline for a live demonstration in Summer 2024. This pipeline runs from the Grangemouth refinery and associated INEOS hydrogen production facility to Granton, on the outskirts of Edinburgh. This pipeline offers an ideal opportunity for the live trial due to its inherent characteristics and is an excellent proxy for the GB LTS. The trial aims to validate research and provide a blueprint (methodology) for repurposing and uprating the 11,000km of pipelines in the GB LTS network.

The programme involves six main packages of work referred to as elements illustrated below:

- **Element 1:** Live trial design & construction
- **Element 2:** Lab material testing
- **Element 3:** Offsite testing
- **Element 4:** Live trial
- **Element 5:** QRA and Case for safety
- **Element 6:** Knowledge dissemination

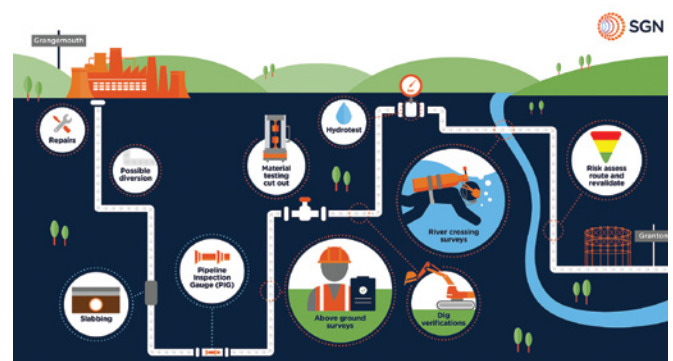


As part of development of the LTS Futures programme, two Stage Gates were identified that feed into Ofgem's funding conditions for the project.

1. Can the Grangemouth to Granton pipeline be repurposed for the live trial?
2. Can the project proceed to live trial of the Grangemouth to Granton pipeline?

A comprehensive suite of work has been carried out on the Grangemouth to Granton pipeline pertinent to feeding into Stage Gate One, evidencing the viability of the asset to convey 100% hydrogen. Assessments have included:

1. Detailed line walk
2. Test post survey, Close Interval Potential Surveys (CIPS) and Direct Current Voltage Gradient (DCVG) surveys
3. Dig verifications
4. River crossing surveys
5. Modifications of the Granton and Grangemouth terminus of the pipeline for pigging and hydrotest operations
6. Pigging
7. Hydrotest
8. Material cut out for laboratory analysis
9. Quantified Risk Assessment (QRA)



All works on the Grangemouth to Granton pipeline were carried out successfully and form key evidence in the suitability of the pipeline to be utilised for the live trial. The evidence was compiled with project partners, Pipeline Integrity Engineers, into a TD/1 repurposing report which made recommendations on modifications and a maintenance strategy to be actioned prior to the live trial. In addition, a site specific QRA for the live trial pipeline was completed to evaluate the transition from natural gas service to hydrogen. This included a review of hazard distances, population infringements and societal risk from the pipeline when in hydrogen service. The QRA makes use of conservative assumptions which will be updated following results of test work. Outputs from this showed that the transition from natural gas to hydrogen did not pose an excessive risk and all were within the HSE's broadly acceptable range.

In April evidence was submitted to Ofgem for Stage Gate One and we received approval at the end of April that the requirements had been met and the project could proceed with works towards Stage Gate Two. As a result of this approval, the project commenced two stakeholder engagement events in May with landowners and local businesses in the region to inform them of plans for the pipeline to be utilised for the live trial. Both events were successful and provided an opportunity for stakeholders to ask about the project. The LTS Futures formal launch event is scheduled for summer 2023, however significant engagement has been made with key stakeholders such as Ofgem, DESNZ and the HSE on project developments to date.

In addition to enabling works on the Grangemouth to Granton pipeline, a detailed design process is under way for a new hydrogen supply pipeline from INEOS refinery to the Grangemouth terminus of the pipeline. This pipeline will provide a source of hydrogen for the live trial. Construction is scheduled to start in Autumn 2023. Design for a hydrogen entry unit and flare are also due to commence with specifications being developed by DNV. This will allow hydrogen to be metered into the pipeline and the flare will create a downstream demand generating flow in the pipeline for hot works demonstrations.

A programme of full-scale testing is being carried out at DNV Spadeadam which will support the live trial operations and development of the blueprint. The test programme involves development of welding procedures and hot tapping trials for hydrogen pipelines which will be utilised to

demonstrate making of a new connection to the pipeline during the live trial. Full-scale burst and fatigue tests which, combined with materials testing, will allow examination of the effects of hydrogen on pipeline defects and failure modes. This information will be used to update QRA models providing a realistic view of the risks from hydrogen pipelines in the same way risks from natural gas pipelines are currently assessed. Venting and flaring tests were carried out in November 2022 to review thermal radiation and overpressures levels from delayed ignition that could be produced. Venting is currently carried out as part of routine maintenance operations and an understanding of how these could be different with hydrogen is needed to determine if changes are needed to operating procedures.

Laboratory testing is being carried out by The Welding Institute on Grangemouth to Granton and generic LTS pipeline material in both air and hydrogen. This will produce comparable results in both environments allowing us to understand failure points with hydrogen and therefore influence the acceptability of defects (acceptable, repair or replace) and provide the relationship between the two parameters and associated tolerance, which will be incorporated into the QRA and blueprint methodology for repurposing LTS pipelines.

Procedures and processes developed on Grangemouth to Granton pipeline material during off site testing will then be demonstrated as part of the live trial starting in Summer 2024. These will include:

- Hot works
- Emergency response simulation
- Capacity assessment

Further to this, the live trial will enable personnel to gain valuable experience in operating and monitoring a hydrogen pipeline in addition to the training packages which will be developed for the program.

The learning developed from testing, trials and demonstrations will inform a blueprint. It will define what needs to be done to confirm that a pipeline is suitable for repurposing as well as providing a cost estimate for the works. This will enable a GB-wide review of the LTS system and provide an understanding of the role it could play in the energy transition.

# Strategic Innovation Fund

## Facts and Figures



**Round 1 = 10 projects approved in total**

- **Discovery (6)**
- **Alpha (4)**

**Round 2 = 6 projects approved in total**

- **Discovery (6)**

## Challenge themes



**Round 1 challenge themes below with the projects carried out.**

### Data and Digitalisation (7)

#### 1. Digital Twin - Exploring the societal, operational and cross industry whole system benefits on the Gas Distribution (Discovery)

- To test and demonstrate the use of a Digital Twin to enhance decision making across a range of challenges driven by energy transition to a sustainable future.

#### 2. Digital Twin: Exploring the commercial, societal and operational benefits on green hydrogen projects (Discovery)

- To create a working green hydrogen digital twin, combined with analytical tools and machine learning, will provide a platform that changes the traditional way of how we look at the analysis of asset condition and performance.

#### 3. Gas System of the Future - Digital Twin (Alpha from two Discovery)

- The unification of two SIF Discovery Phase projects (a hydrogen production digital twin and a gas network digital twin) forms the basis of our project, which for the Alpha Phase aims to explore further the commercial, societal and operational benefits that could be derived from the deployment of a unified “gas system of the future” digital twin.

#### 4. Intelligent Gas Grid (Discovery & Alpha)

- Using Utonomy’s remote control pressure system the project vision is to autonomously and intelligently monitor and control networks, both in terms of pressure management and operational planning and maintenance, using data-driven algorithms and decision-making, and to support network digitalisation.

#### 5. Predictive Safety Interventions (Discovery & Alpha)

- Currently, the process for reducing lost-time injuries involves a large manual data-capture effort and experimental process changes. By the nature of this process, a worksite is already unsafe before anything is done to prevent it. Instead of waiting for a site to become unsafe, FYLD and SGN want to analyse which conditions contribute the most to worksite safety, then multiply them throughout the network.

This will look to expand the capability of FYLD into predictive analytics, that may pose a high risk to employee safety as the day’s operations unfold and enable remote, proactive safety interventions.

## Heat (2)


### 1. Velocity design with hydrogen (Discovery & Alpha)

- This project will deliver a test campaign, on a full-scale test rig, to produce data that will be accepted by the industry and the professional body representing gas engineers in the UK as valid to amend the design codes to ensure the safe transport of hydrogen in UK gas distribution infrastructure.

## Transport (1)

### 1. NAVIGATION (Discovery)

- This project looks to demonstrate how predictive grid mapping AI, fuel-flexible, pollutant-free power generation, and real-time optimisation and control technology can enable the use of gas network, as it evolves to 100% renewable, as an alternative energy vector for the power provision for ultra-rapid EV charging infrastructure.



**Round 2 challenge themes have been refined where SGN have been awarded six projects in the initial Discovery phase. These projects will commence next financial year 23/24.**

## Supporting a just energy transition (1)

### 1. Hy-Fair

- Hy-Fair will identify and quantify the needs for more tailored support, and then develop and trial the innovative social and technological solutions required to make the hydrogen transition work for everyone.

## Improving energy system resilience and robustness (2)

### 1. Distribution Network Information Modelling (DNIM)

- DNIM aims to support the energy transition with the development of a cost effective and non-disruptive robotic system that will internally map and analyse the entire gas distribution network in a cost-effective manner.

### 2. Looking-Glass

- Project Looking-Glass will provide real-time assessment of Network Operator's resilience and robustness through big data analysis of infrastructure and security data, ensuring the networks are secure during the Net Zero transition.

## Accelerating decarbonisation of major energy demands (3)

### 1. Calfacto Latent Energy

- This project is to assess the efficiency of hybrid heat pumps when coupled with thermal stores through an innovative heat exchanger design.

### 2. Carnot Gas Plant

- The project is to develop a Carnot Gas Plant integrated with a heat network to provide efficiency improvements and cross-vector flexibility.

### 3. Net Zero Community Energy Hubs

- This project looks at developing models and control systems for co-location of heat networks behind the meter with flexible assets.

# Price Control Deliverables

As part of SGN's GD2 determination, the project relates to the OFGEM approved Price Control Deliverable – Gas Emission Reduction. The project will include the procurement of products for full rollout across the Scotland and Southern regions for the remainder of the GD2 period which includes equipment and techniques that aim to reduce gas emissions.



The implemented solutions will reduce our gas emissions while making the working environment safer for our operatives when managing gas escapes.

At the start of the projects the innovations have a TRL of 8 and on the completion will have a TRL 9. SGN is exposed to various stakeholders and environments that can damage our assets. Through third party accidents or issues on our network may result in high volume and dangerous gas escapes.

Gas escapes are uncommon, however, can pose a severe risk to individuals and infrastructure in their vicinity, due to the volume of gas released and the manpower required. They also have the potential to significantly disrupt supply to customers resulting in interruptions to supplies for extended periods.

The Stent Bag and High Volume Gas Escape Toolbox (HVGET) solution offers a safe and more efficient alternative that maintains security of supply to our customers downstream. The Stent Bag innovative equipment allows security of supply to be maintained while our operatives isolate the section of main in a safe environment; out with the hazardous area of the escape itself.

## Stent Bag

The Stent Bag equipment has been developed from the successful learning gained from the Network Innovation Allowance projects Stent Bag (Stage 1) developed for up to 2barg on metallic pipe, where Stent Bag (Stage 2) will focus up to 7barg on up to 12" PE and metallic pipelines. The process developed involves inserting a sealing stent system into the main remotely away from the gas escape. The Stent Bag is then internally pushed along the main and expanded to seal the area around the leakage point. Unlike a traditional flow stop bag the stent maintains the flow of gas to any customers downstream of the affected area.



## High Volume Gas Escape Toolkit (HVGET)

The purpose of this HVGET enables a safer and smarter process of stopping the escape via a range of interim and permanent repair options that allows the problem to be solved safer, quicker and cheaper. The project has developed four tools which make up the toolbox. Each tool has their own specific use depending on the type of leak encountered.



# Next steps

Our team has accomplished several innovation projects which have significantly improved network performance this year. We're committed to maintaining this momentum as we embark on the next phase of our journey through the current price control period. We'll remain dedicated to aligning ourselves with the joint Innovation Strategy as well as meeting the following objectives:

## Future of Energy

Our objective is to stay attentive and flexible toward the evolving energy requirements of our customers and stakeholders. We're aiming to stay attentive and flexible towards the reliable ways to showcase, exhibit and enable decarbonisation and comprehensive system solutions.



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## Engagement

We are committed to nurturing and establishing critical partnerships to fuel innovation and progress throughout the industry. With a focus on sustaining and expanding these important relationships, we will continue to drive growth and development in pursuit of our shared objectives.

## Efficiency

We aim to innovate by exploring and creating new products, advanced techniques, and innovative ways of working. Our commitment towards improving the efficiency of our processes and finding novel ways to add value for our customers is our top priority.



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## Implementation

Our team will collaborate with all departments to ensure the successful implementation of valuable projects.



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Facebook**

If you smell gas or are worried about gas safety, you can call the National Gas Emergency Number on **0800 111 999**

Carbon monoxide (CO) can kill.  
For more information:  
**[https://www.sgn.co.uk/help-and-advice/  
keeping-gas-safe/carbon-monoxide](https://www.sgn.co.uk/help-and-advice/keeping-gas-safe/carbon-monoxide)**