UKOPA Technical Seminar

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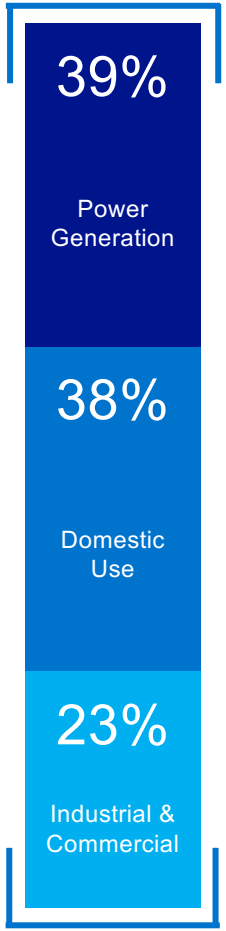
The Role of Gas in the UK

Gas Demand in the UK today:

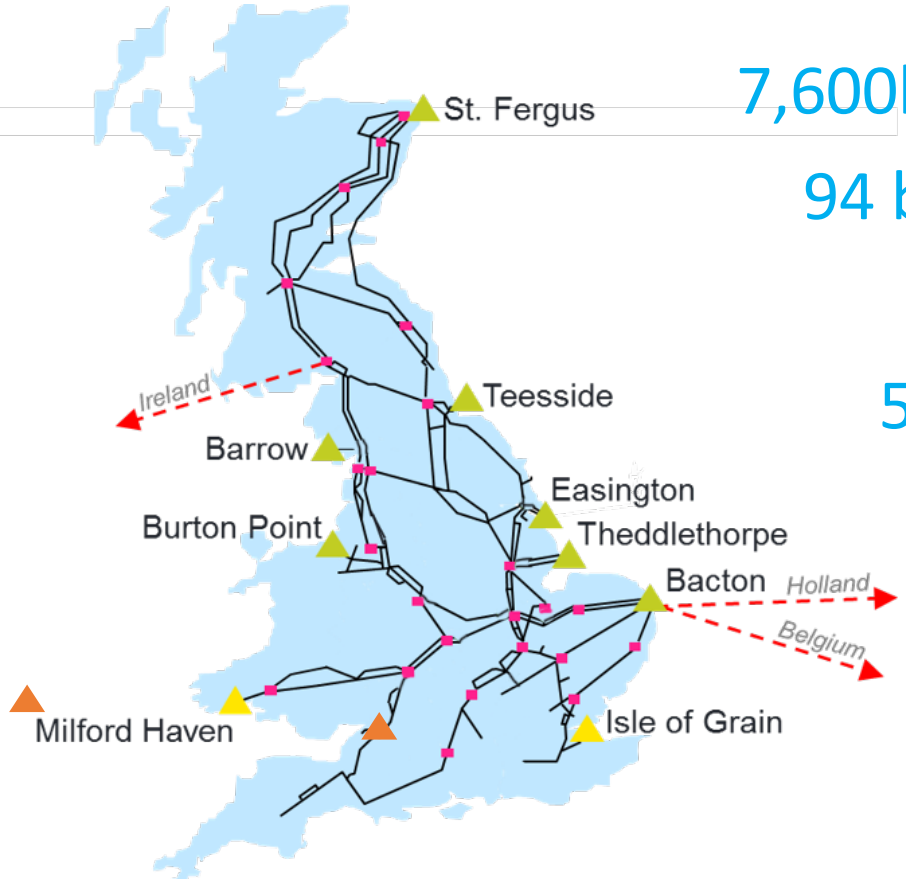
22m
gas customers across the UK

85%
households are using gas for heat

881TWh
of energy is delivered by the NTS



The National Transmission System (NTS):



7,600km high-pressure pipe

94 bar maximum pressure on the network

24 compressor stations

504 above-ground installations

8 connected distribution networks

- Gas transmission pipeline
- Gas terminals
- Compressor stations
- LNG importation terminal

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Developing a UK hydrogen backbone

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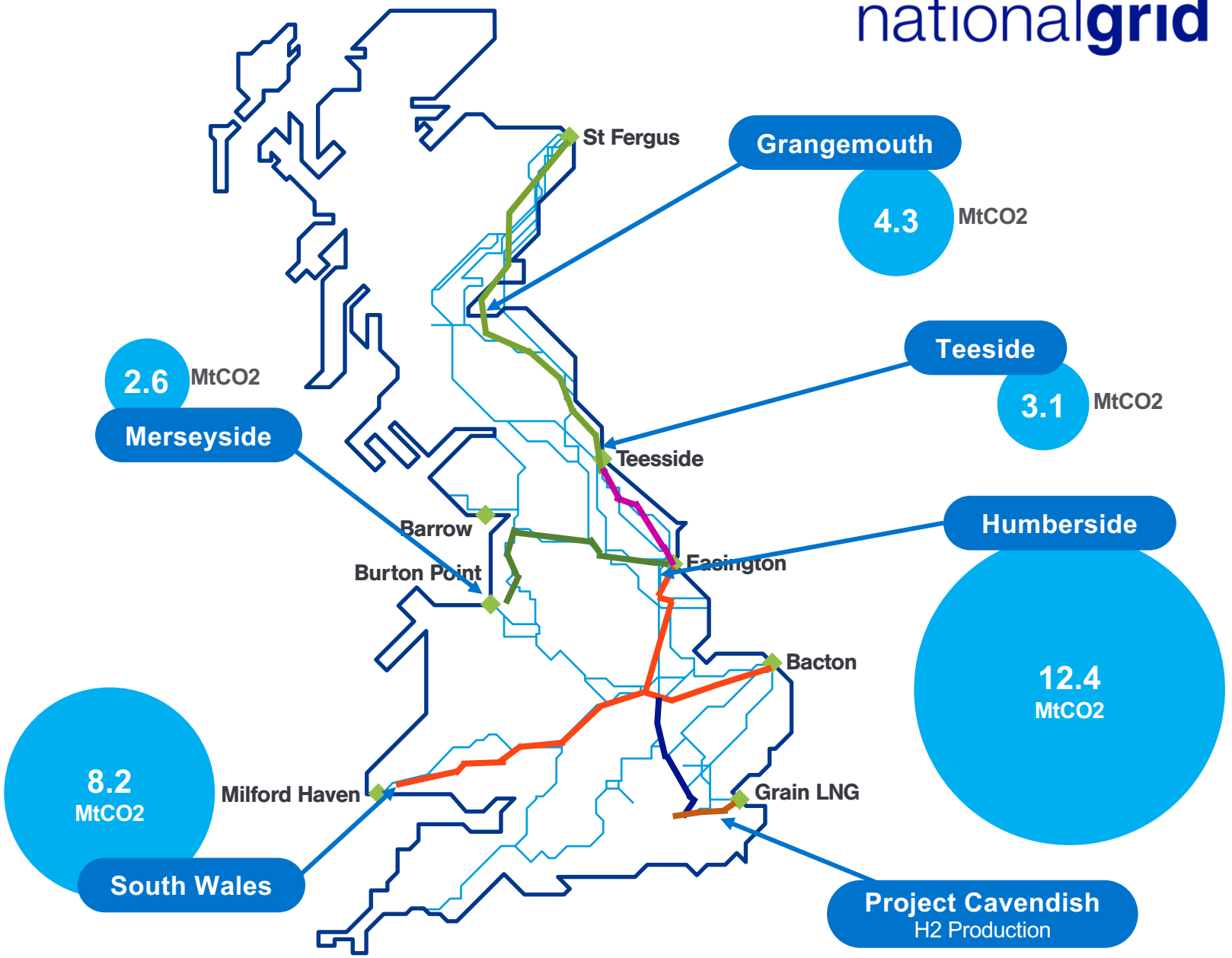
HyNTS ProjectUnion

Project Union will review the potential phased repurposing of NTS pipelines to carry hydrogen and provide a hydrogen transmission 'backbone' for the UK

- Teesside – St Fergus
- Humber –Teesside
- Humber – Merseyside
- South Wales – Bacton – Humber
- East Midlands - Cavendish
- Cavendish - London



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An ambitious programme to build a hydrogen test facility from decommissioned assets at DNV's facility in Cumbria to demonstrate the National Transmission System (NTS) can transport hydrogen.

DNV

DNV Engineering Research & Development Centre – Spadeadam, Cumbria

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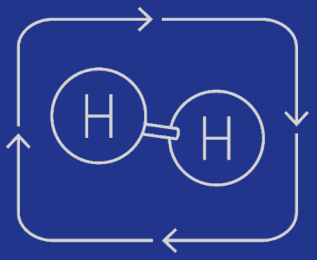
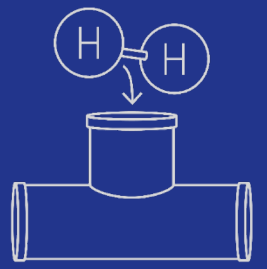
An ambitious programme to build a hydrogen test facility from decommissioned assets at DNV's facility in Cumbria to demonstrate the National Transmission System (NTS) can transport hydrogen. Testing will be completed in two parts:



Offline Hydrogen Test Facility

NTS assets of different types, sizes, and material grades will be tested with 2, 20 & 100% hydrogen



Standalone Hydrogen Test Modules

Standalone hydrogen test modules will provide key data required to feed into the main facility

This will help us understand how hydrogen interacts with our assets, so that we can develop the appropriate safety standards required to operate our network.

Construction is now underway with testing on the main Offline Hydrogen Test Facility set to begin mid 2022.

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Phase 1 Overview

Work Package
1A
Build & Commission

Starts: July 2021
Completes: October 2022

Work Package
1B
2, 20 & 100% Hydrogen Testing

Starts: October 2022
Completes: April 2023

Work Package
1C
QRA & Safety Case

Starts: June 2021
Completes: June 2023

Work Package
1D
Dissemination & Reporting

Starts: July 2021
Completes: July 2023

FutureGrid Phase 1 Delivery & Phase 2 Development

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Work Package 1A Build & Commission | Work Package 1B | Work Package 1C | Work Package 1D

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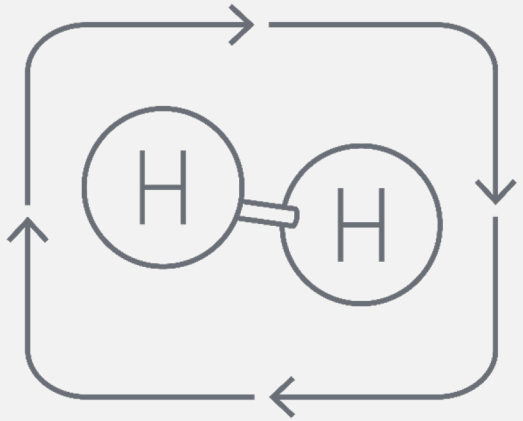
Test Facility Set Up

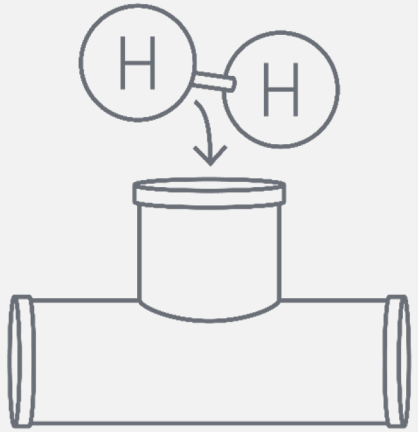


Offline Hydrogen Test Facility

A representative range of NTS assets of different types, sizes, and material grades are being supplied from decommissioned assets to build the hydrogen test facility.

The facility will initially run on 100% natural gas to collect baseline data for the equipment and then move through 2%, 10% and 20% hydrogen / natural gas mixtures and then 100% hydrogen.

The facility will have a maximum flow of 1.76 MSm3/day generated by the use of a gas compressor.



Standalone Hydrogen Test Modules

Standalone hydrogen test modules will operate alongside the main test facility, to provide key data required to feed into the main facility including:

(1) Material Permeation Testing

(2) Pipe Coating & CP Testing

(3) Fatigue Testing

(4) Flange Testing

(5) Asset Leak Testing

(6) Rupture Testing

FutureGrid Phase 1 Delivery & Phase 2 Development

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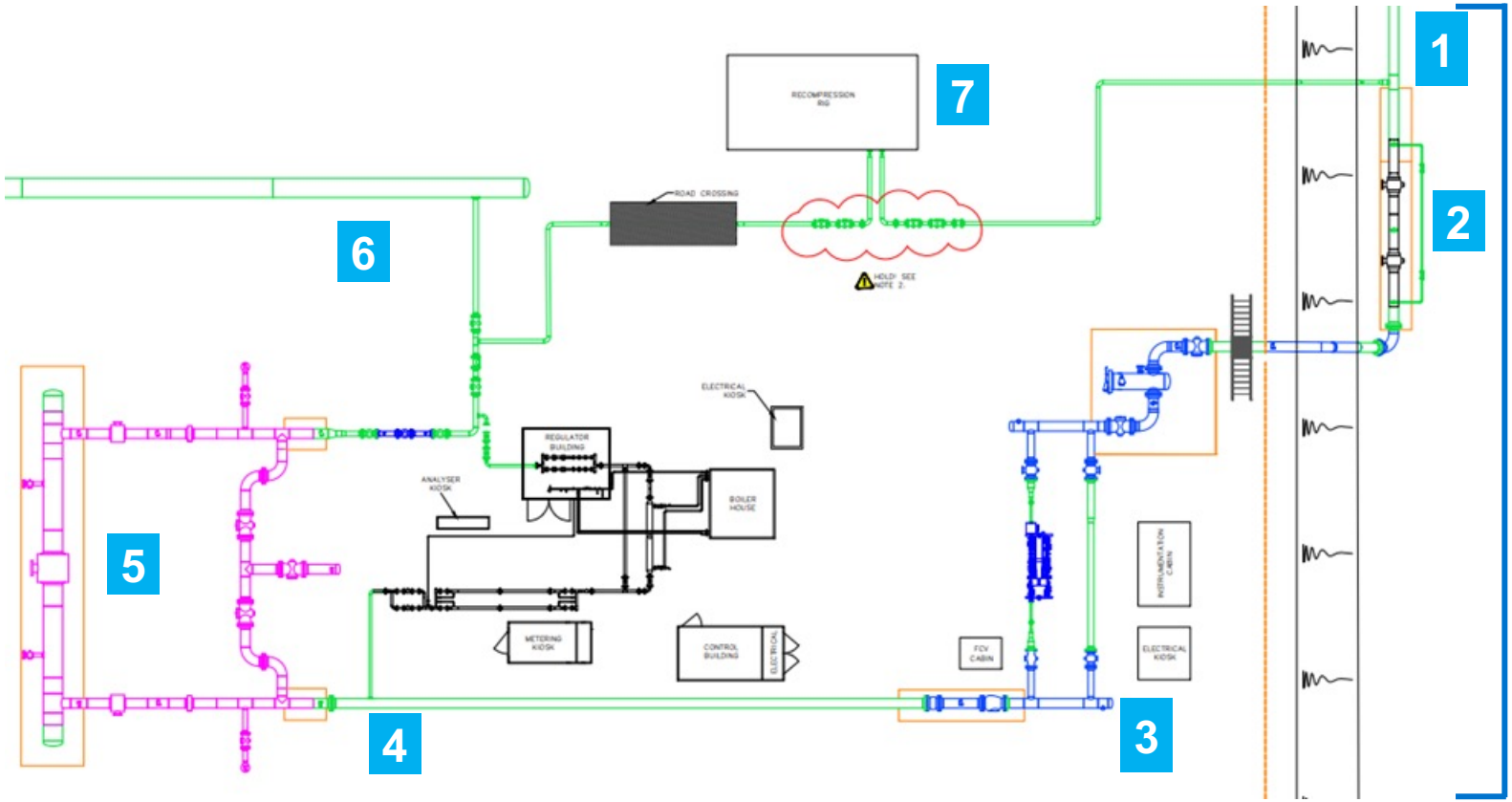
Work Package 1A Build & Commission | Work Package 1B | Work Package 1C | Work Package 1D

Gas Transmission and Metering

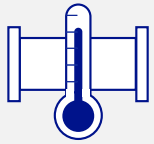
Offline Hydrogen Test Facility



Key Instrumentation:

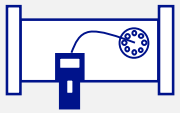
Metering

Pressure



Temperature

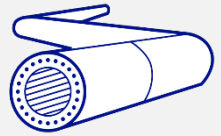
Noise



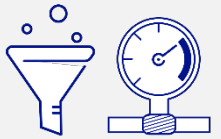
H_2 Flux

Vibration

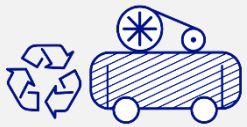
Mechanical Assets:



Steel Pipeline
Pipe grades X52, X60, X65
Welds
Bends, tees, flanges



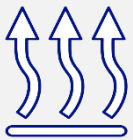
Filters & Meter Stream
Orifice Plate Meters
Ultrasonic Meters



Recompression Unit
Generate flows of facility

Valves
Ball Valves
Plug Valves

Flow Control Valves



Pre-Heater & Regulators
Pre-Heating at up to 20% blend
Pressure Reduction Equipment

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Construction Progress

Work Package 1A **Build & Commission** | Work Package 1B | Work Package 1C | Work Package 1D

Gas Transmission and Metering

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Work Package 1A Build & Commission

Work Package 1B

Work Package 1C

Work Package 1D

Gas Transmission and Metering

Pipework Fabrication

Installing the Assets

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Hydrogen Testing Plan

Three concentrations of hydrogen will be tested:

2%
hydrogen in natural gas

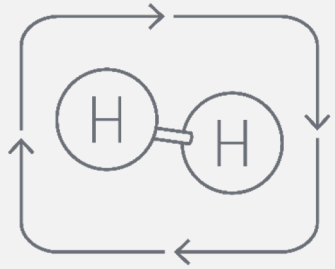
20%
hydrogen in natural gas

100%
hydrogen

Operate the offline test facility for 7 months across the 3 H_2 concentrations with the standalone test modules running throughout the 2 year period.

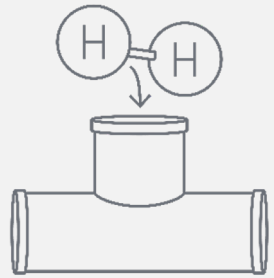
Review and evaluate the test results utilising the Fluxys Fast Screening Methodology allowing for the extrapolation of results across the NTS.

Validate flow parameters such as gas velocities, pressures, energy delivery to understand how we need to operate the NTS with a hydrogen blend (or 100%).



Offline Hydrogen Test Facility

A representative range of decommissioned NTS assets of different types, sizes, and material grades will be tested with 2, 20 & 100% hydrogen



Standalone Hydrogen Test Modules

Standalone hydrogen test modules will operate alongside the main test facility, to provide key data required to feed into the main facility

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Work Package 1A | Work Package 1B: 2, 20 & 100% Hydrogen Testing | Work Package 1C | Work Package 1D

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Standalone Hydrogen Test Modules

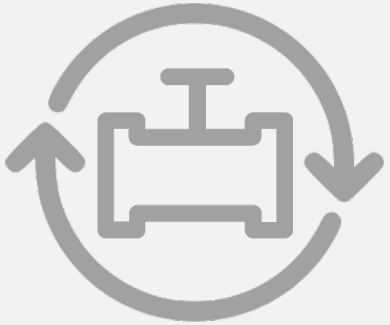
Material Permeation Testing

This test will determine the rate at which hydrogen permeates through the pipe wall in a pressurised hydrogen environment. This will inform the soak time required for full saturation on other tests.

Pipe Coating and CP Testing

These tests will assess the impact of hydrogen on internal pipe coatings as well as the cathodic protection system to identify any issues.

Fatigue Testing

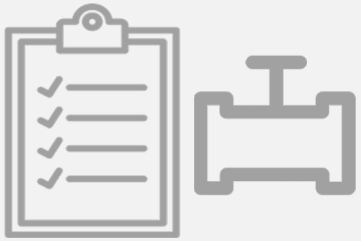


To demonstrate the NTS can endure tens of thousands of pressure cycles in hydrogen service.

Flange Testing

To assess the effect of hydrogen on RF and RTJ flanged joints.

Asset Leak Testing



Hydrogen is significantly more prone to leaking than natural gas. We need to understand the extent of this to determine if additional mitigations are required.

Rupture Testing

Investigate overpressures caused by delayed ignition of ruptures on a buried line containing 100% hydrogen. 36” NB gas storage array to provide the necessary gas flow.

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Stand Alone Leak Testing Almost Complete

Gas Transmission and Metering

Leak test setup for the 36” ball valve.

Testing will involve hydrostatic testing, natural gas test, and hydrogen test.

The valve seats will be leak tested with pressure testing applied from each side of the valve.

Flange leak test

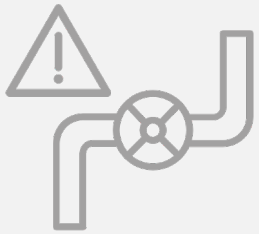
Safety and Risk Management

There is a fundamental difference between how natural gas and hydrogen behaves. We must be able to understand the impacts of different concentrations of hydrogen and develop our safety standards:

Procedure Review

Categorisation of NG procedures as high, medium, low impact with a report detailing the methodology findings and next steps for each.

Hazard Assessment of the Transmission System (HATS)



Provide an updated HATS for the NTS pipelines, based on the network transporting hydrogen instead of Natural Gas

Quantitative Risk Assessment (QRA)

Record and update the Hazard Assessment Methodology Manual (HAMM) where deviations are required for assets transporting Hydrogen.

Hazardous Area Impact

Hazardous Area Drawings (HADs) will be produced for each asset type at the 20% & 100% hydrogen and will be compared to existing Natural Gas HADs with a technical report outlining the consequences

Overpressure Risk (OR)

Identify whether the existing methodology can be adapted for 100% hydrogen. If needed, develop an appropriate methodology for risk analysis and emergency planning purposes.

NGGT Safety Case

Assess and update the NGGT safety case (policies, procedures and work instructions) depending on the impact of hydrogen.

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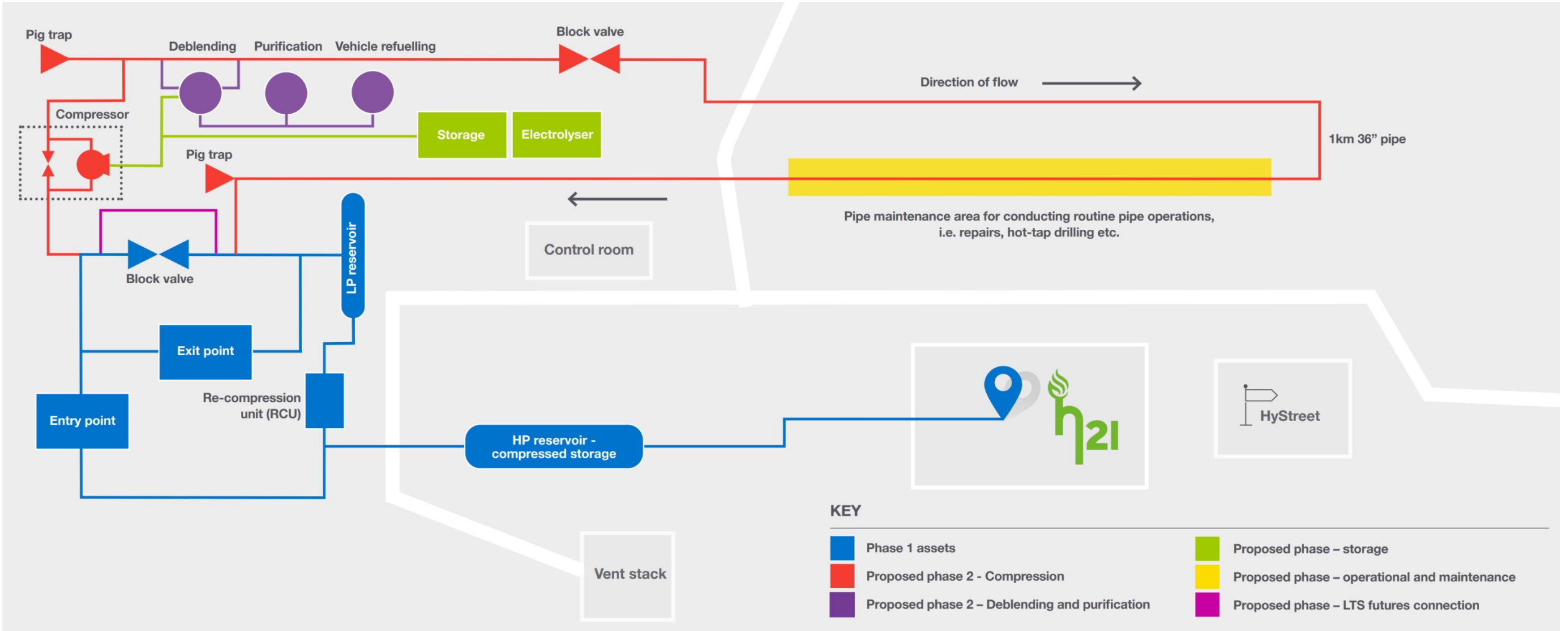
Phase 2 Expansion Potential – SIF Applications

Gas Transmission and Metering



Key SIF Applications

HyNTS Compression

This project investigates the key challenges associated with compression of hydrogen using existing national transmission system (NTS) assets. This project will also provide the capability for critical operations such as In-Line Inspection (ILI) to be tested at FutureGrid.

HyNTS Deblending & Purification

This project aims to provide an offline demonstration of gas separation or 'deblending' technology on a gas network scale. The project aims to develop a skid mounted, mobile solution to demonstrate hydrogen fuelling from the NTS for the future transport network.

Additional SIF's

Fuel cell gas analyser & data analytics

This project aims to demonstrate a fuel cell gas analyser for blends of hydrogen and natural gas for up to 100% hydrogen in the NTS.

EcoNET telemetry

The EcoNet programme sets out to create a pathway to modernise the future telemetry solutions. The project builds on previous work to deploy a robust future proofed telemetry system.

Hydrogen metering

This project will explore options for gas metering equipment for use with hydrogen. There will be scope for demonstration of new technology potentially at FutureGrid.

HyNTS pipeline data set

This project will aim to obtain information on the current condition of pipelines for the transition to hydrogen to determine suitability of pipelines for repurposing.

Hydrogen barrier coatings for gas network assets

This project looks into the potential for deployment of hydrogen barrier coatings via electrodeposition onto the internal surface of a pipelines and other assets.

thank you!

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