HyNTS:
Hydrogen in the NTS

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HyNTS FutureGrid
The Role of Gas in the UK

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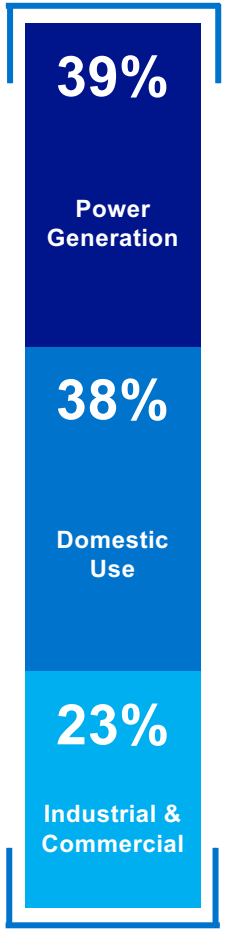
Gas Demand in the UK today:

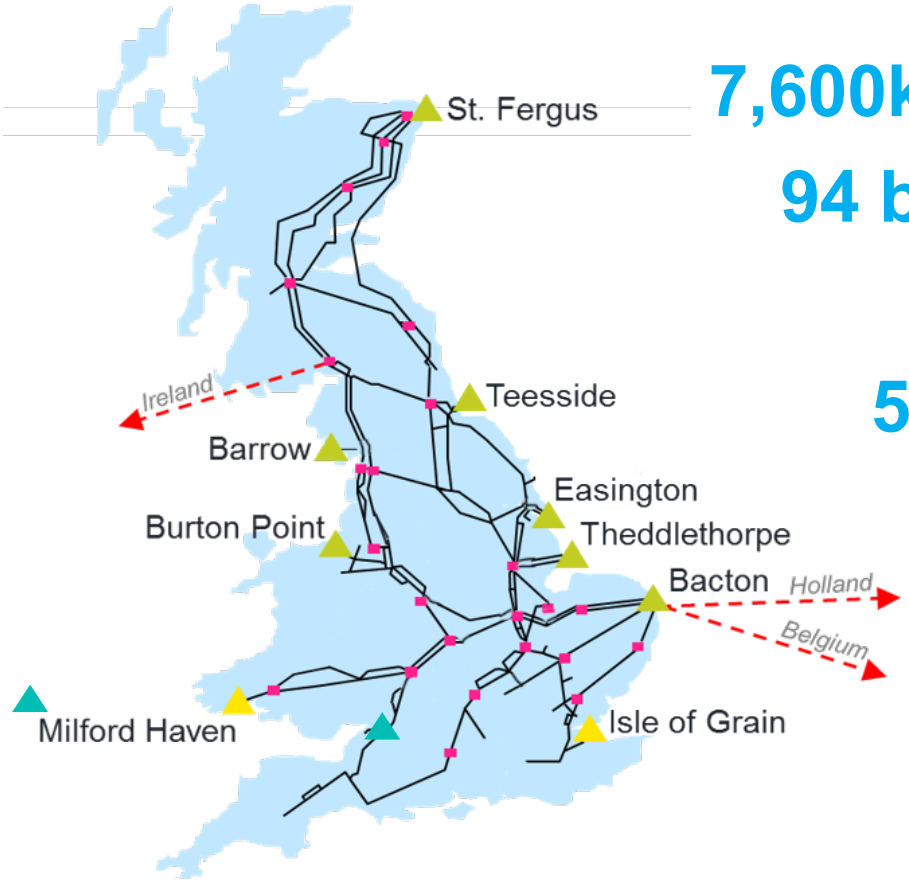
22m gas customers across the UK

85% households are using gas for heat

881 TWh 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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Common Goals for the UK & EU

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	UK	EU
Green House Gas Emissions	**1990 – 2019** 800 → 435 million tonnes per year	**1990 – 2017** 5 700 → 4 500 million tonnes per year
Ambition	**Net Zero by 2050** UK target	**First carbon neutral continent by 2050** EU target
Faster Decarbonisation	**37% generation** in 2019 was renewable energy	**50/55% renewable energy target** for 2030 under discussion
Key Focus	**Industrial decarbonisation** Followed by transport and heat with a whole systems approach across gas and electricity (with energy efficiency as a core principle)	**Energy efficiency first principle** Focus on electrification (40 – 50 %) with role & benefits of the green gas & green fuels confirmed (SOS, cost-effectiveness, flexibility)
Hydrogen	**Clean hydrogen (blue / green)** Starting now & gradually building up from local clusters to a hydrogen backbone, open and competitive hydrogen market (cross border, open access, unbundling principles)	

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Why Hydrogen?

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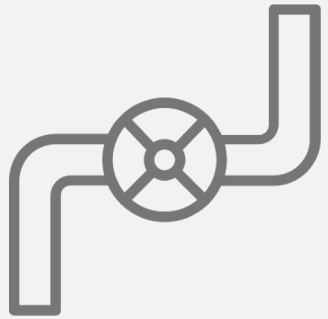
Hydrogen is a clean and abundant alternative to methane (known as natural gas)

Hydrogen is a future clean energy source only releasing water vapour when it is burned

Hydrogen is already used as a fuel for transport and is being trialled internationally

Blue Hydrogen is produced from non-renewable sources using Steam Methane Reformation and Autothermal Reforming

Green Hydrogen is produced using electrolysis to produce hydrogen from renewable electricity



Challenge to economically produce hydrogen at scale, and adapt the existing infrastructure for hydrogen

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Building A Collaborative Pathway to a Greener Future

Gas National Transmission Network (NTS):

£6.3bn
value of the existing assets

7660km
high pressure pipelines

NTS carries
3/4
of GB energy today

Collaboration has been key to developing our hydrogen capabilities:

HyDeploy
H21
HyNet

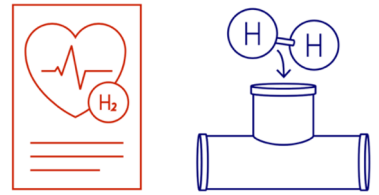
GDN projects have positive results and have not found any show stoppers

Department for Business, Energy & Industrial Strategy
GAS GOES GREEN

Hydrogen Programme Development Group (HPDG) and Gas Goes Green (GGG)

snam gasunie

International hydrogen demonstration with significant learning and knowledge shared



HyNTS programme has provided desktop evidence of the NTS capability & capacity

NTS Pathway to a Net Zero Future

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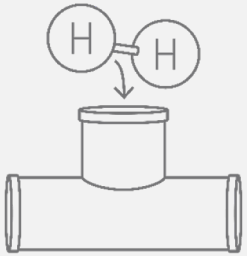
HyNTS Programme Overview – Completed Projects

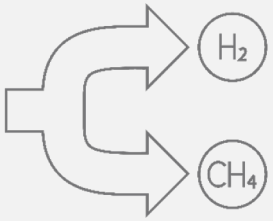
HyNTS is a programme of work that seeks to identify the opportunities and address the challenges that transporting hydrogen within the National Transmission System (NTS) presents. This will unlock the potential of Hydrogen to deliver the UK's 2050 Net Zero targets.

NTS Hydrogen Injection



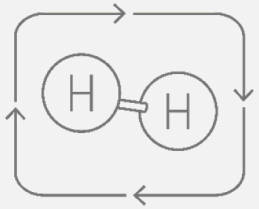
To identify the requirements to enable a physical trial of Hydrogen injection into the NTS, identifying the gaps in the safety case and indicating the most suitable NTS location for a live small-scale trial.

Hydrogen Deblending



To assess a variety of hydrogen recovery technologies and develop concept designs for selected options including a techno-economic review and identify the requirements for a demonstration project.

Hydrogen Flow Loop



Offline test loop to evaluate metallurgy changes on existing NTS steel pipe and new MASIP pipe when exposed to 30% hydrogen, identifying next steps to assess the NTS' suitability to transport hydrogen.

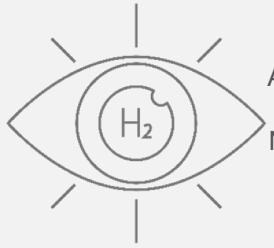
Feasibility of H2 in the NTS

A feasibility study with the aim of determining the capability of the NTS to transport hydrogen. Includes a review of relevant assets, pipeline case study and draft scope for offline trials.

Project Cavendish

A review of the potential of the Isle of Grain region to use existing infrastructure to supply hydrogen to London & the South East including generation, storage, transport and CCS.

Aberdeen Vision



A feasibility study for the generation of hydrogen at St Fergus using the NTS (up to 2%) to supply the city of Aberdeen. Includes generation, injection, separation and transport.

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Collaborating to develop our hydrogen knowledge

Materials considerations

Pipelines and mechanical assets eg:
- Hydrogen embrittlement
- Seals & soft parts
- Weld quality

Safety developments

Risk assessment and new safety case development including:
- Hazardous areas
- Electrical equipment
- Plant operations

Flow characteristics

How will hydrogen move around our network?
- Gas velocity
- Pressure drop
- Saltation

Compression

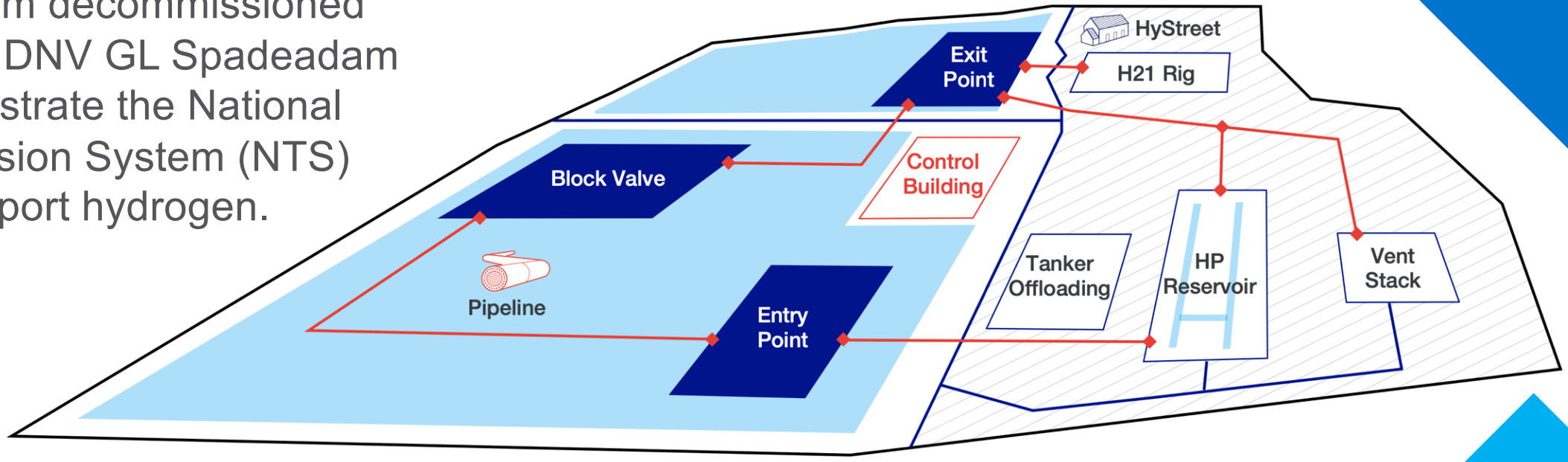
What will need to change in our compressor strategy?
- Turbine compatibility
- Gas compressibility
- Investment cycles

Network management

How do we ensure we can maintain security of supply?
- Storage capacity
- Network inputs
- Deblending

HyNTS FutureGrid

This ambitious programme seeks to build a hydrogen test facility from decommissioned assets at DNV GL Spadeadam to demonstrate the National Transmission System (NTS) can transport hydrogen.



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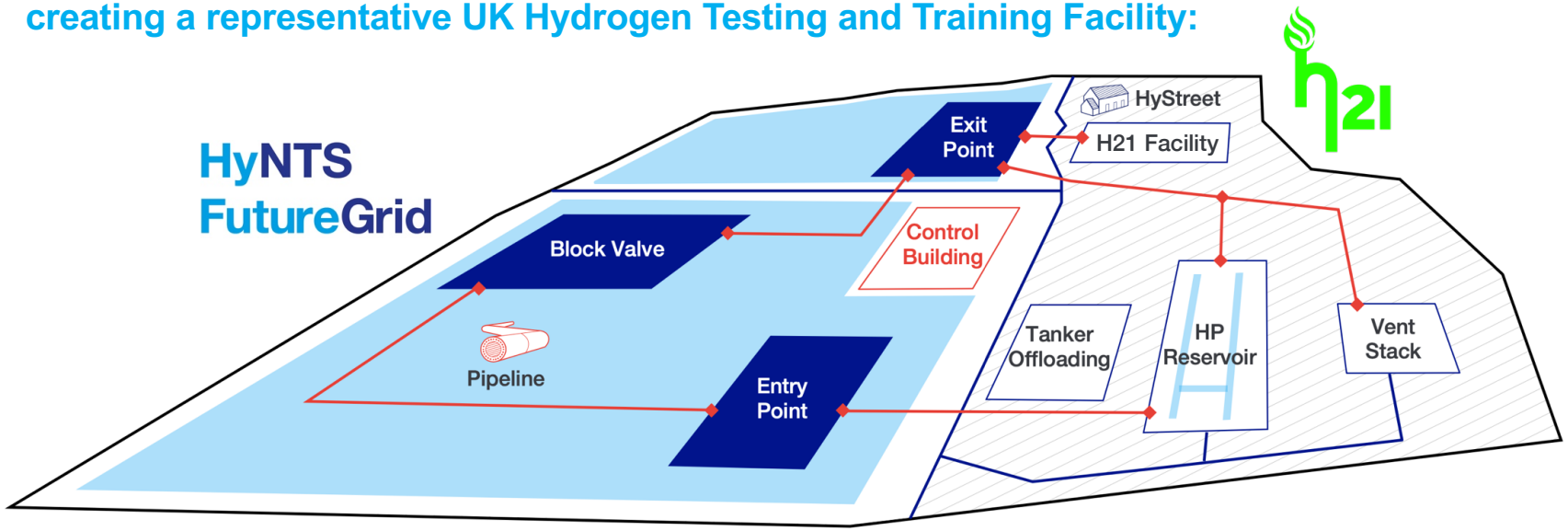
Building a Testing & Training Facility for the UK

The FutureGrid test facility will be built at DNV GL's Spadeadam Site:

The FutureGrid test facility will connect to the H21 distribution facility creating a representative UK Hydrogen Testing and Training Facility:



'Beach to Burner' UK Test Network

Digital first approach to engagement

Maximise collaboration and reach

Testing & Training Facility

Train Future Hydrogen Engineers

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Roadmap to FutureGrid Project

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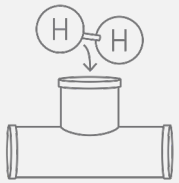
The **Roadmap to FutureGrid** project is key to developing the principles and specification of the proposed offline test facility including the development of a robust testing plan to provide an updated safety case for the NTS.

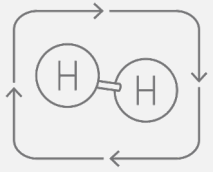
Building on Learning:

This NIA and wider programme of work builds on learning across our portfolio of projects and from across industry projects:

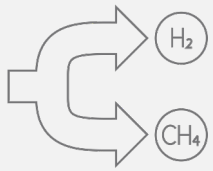
Feasibility of H_2 in the NTS



Hydrogen Injection in the NTS



Hydrogen Flow Loop



Hydrogen Deblending

H21 HyDeploy HyNet REAL-TIME NETWORKS

The NIA Project will deliver 3 key outputs:

1. **Design of the Test Facility**
   Full design of the hydrogen test facility which will include the pipeline configuration, the assets to be tested, injection and mixing points, storage capabilities and flows.

2. **Development of Master Testing Plan**
   Develop the testing plan to validate NTS assets and flow parameters such as gas velocities, pressures, energy delivery and other operating parameters for hydrogen blends up to 100%.

3. **Asset Integrity Testing & Interpretation**
   Design and develop a number of desktop and small scale asset integrity tests with analysis and interpretation of the results to feed into the full design and testing programme.

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Phase 1 Overview

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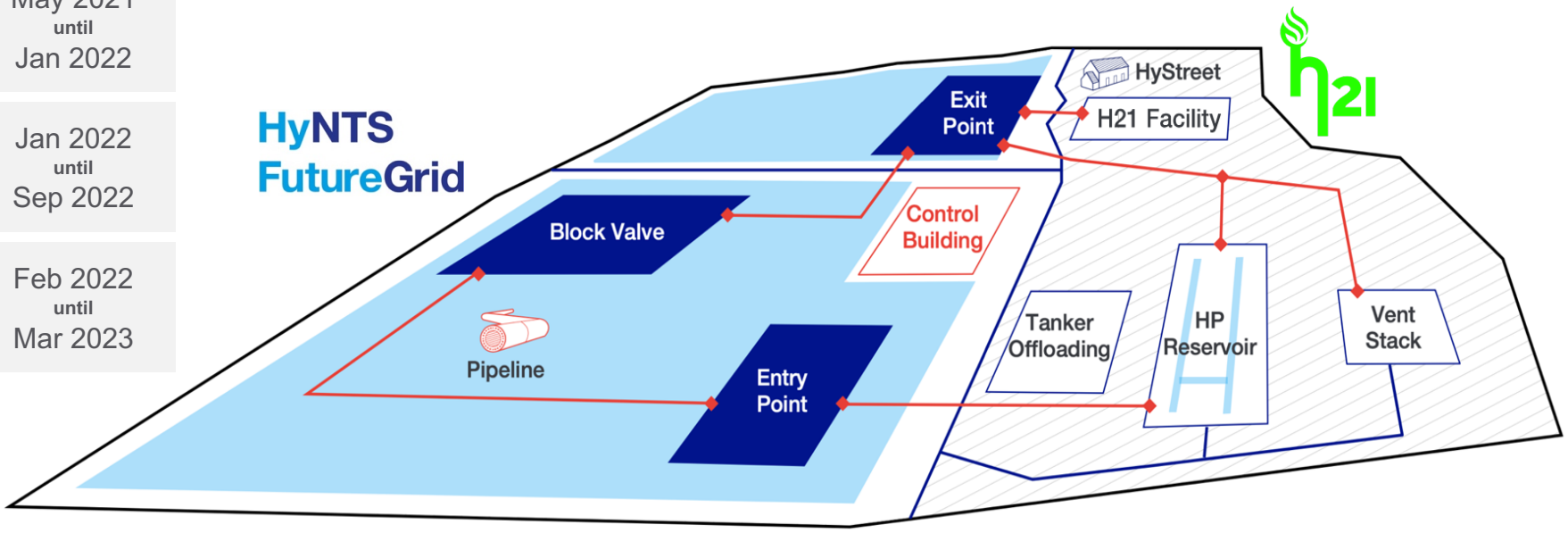
This ambitious programme seeks to build a hydrogen test facility from decommissioned assets at DNV GL Spadeadam to demonstrate the National Transmission System (NTS) can transport hydrogen.

The project will be delivered in three phases:

Phase 1a	Offline Facility Build	May 2021 until Jan 2022
Phase 1b	NTS Asset Testing	Jan 2022 until Sep 2022
Phase 1c	Safety & Risk Impact	Feb 2022 until Mar 2023

The FutureGrid test facility will connect to the existing H21 distribution facility creating a representative UK Hydrogen Testing and Training Facility:



FutureGrid Project Partners:

DNV·GL · HSE · Northern Gas Networks · fluxys · Durham University · The University of Edinburgh

You can find out more across our website and social media or email us at: FutureGrid@nationalgrid.com

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