Blending

We will start at 10.02 to allow participants to finish previous meetings and join the call

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#GT6

Gas
Transmission

Welcome and Opening

Thank you for joining us today

Antony Green

Director of Hydrogen

Who will be speaking?

Lloyd Mitchell

Hydrogen Engineering Lead

Megan Bray

Market Development Analyst

Susannah Ferris

Hydrogen Market Lead

Jennifer Pemberton

Stakeholder Strategy Manager

Logistics

Should last for approximately about 60 min

Questions and polling via slido.com #GT6

Believe in children Barnardo's

All callers will be placed on mute

We will circulate the slides and a recording of this webinar

Agenda

1. Blending – an overview
2. Physical considerations and updates
3. Commercial and market considerations
4. Next steps

What is blending?

Gas Transmission

Innovation
- Materials and processing
- Automation and measurement
- Digital systems and simulation
- Business process and management
- Asset development for risk mitigation

FutureGrid
- 2% H2 asset testing
- 20% H2 asset testing
- 100% H2 asset testing

Regional Programmes
- East Coast Hydrogen
- Capital Hydrogen
- Hydrogen Valley

Sectors
- Heat
- Power
- Industry
- Transport

Hydrogen Policy
- Blending
- Strategic decision on H2 for heating 2026
- T&S business models

Data
- Data specification
- CNI
- Environmental impact

Asset Management
- RIIO-3
- Investments
- Asset Management Plan

Commercial Frameworks
- Trading
- Capacity
- Charging
- Balancing
- Connections
- Gas Quality
- System Operations

Implementation Strategy
- Phasing
- Delivery
- Funding

Supply Chain
- Market engagement
- Procurement

Regulation
- Regulatory framework
- Cost allocation
- Asset repurposing

Customer and Stakeholder
- Stakeholder landscape
- C+S intelligence

Network Modelling
- Methane
- Hydrogen
- Repurposing & newbuild

Engineering Policy
- Policy Framework
- GSMR

ProjectUnion

Dual Pathway to a hydrogen NTS: hydrogen blending and rollout of 100% hydrogen pipeline connections

Delivering a blend of hydrogen across the NTS in parallel to a strategic rollout of 100% transmission pipeline sections

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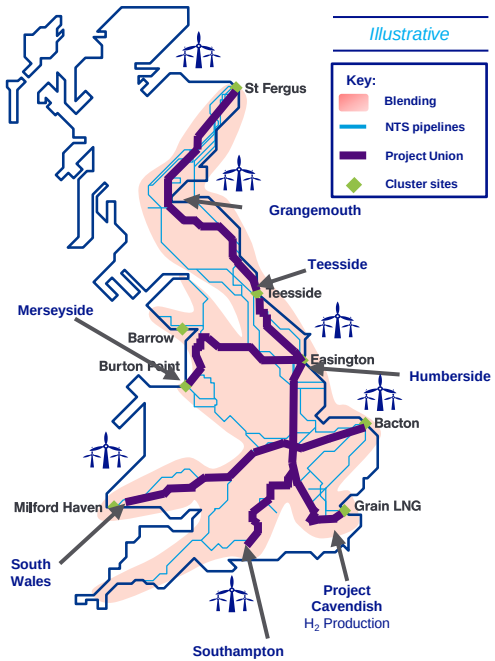
To find out more, please join us on the Transition to 100% webinar – 06th Dec @ 11.00



Rollout of blending across the NTS

Strategic rollout of 100% pipeline connections

Delivering a Dual Pathway to transitioning the NTS to hydrogen:

- In 2024/5 low level hydrogen blending will be facilitated on the transmission network
- From 2025 onwards blending could extend and increase up to 20% - more if deblending technology can be proven.
- In 2028/9 Project Union will deliver the first phases of 100% hydrogen transmission pipeline between the northern clusters
- By 2033 Project Union will have delivered a circa 2000km hydrogen backbone joining key production and use clusters
- Asset conversion continues to 2045 to deliver a complete 100% hydrogen network.

Net Zero 2050

Levelling up, Job Creation

Global Leader in Green Innovation

Providing flexibility and optionality

A dual pathway approach will ensure the most efficient and timely transition to hydrogen whilst ensuring those connected to the network are not left behind

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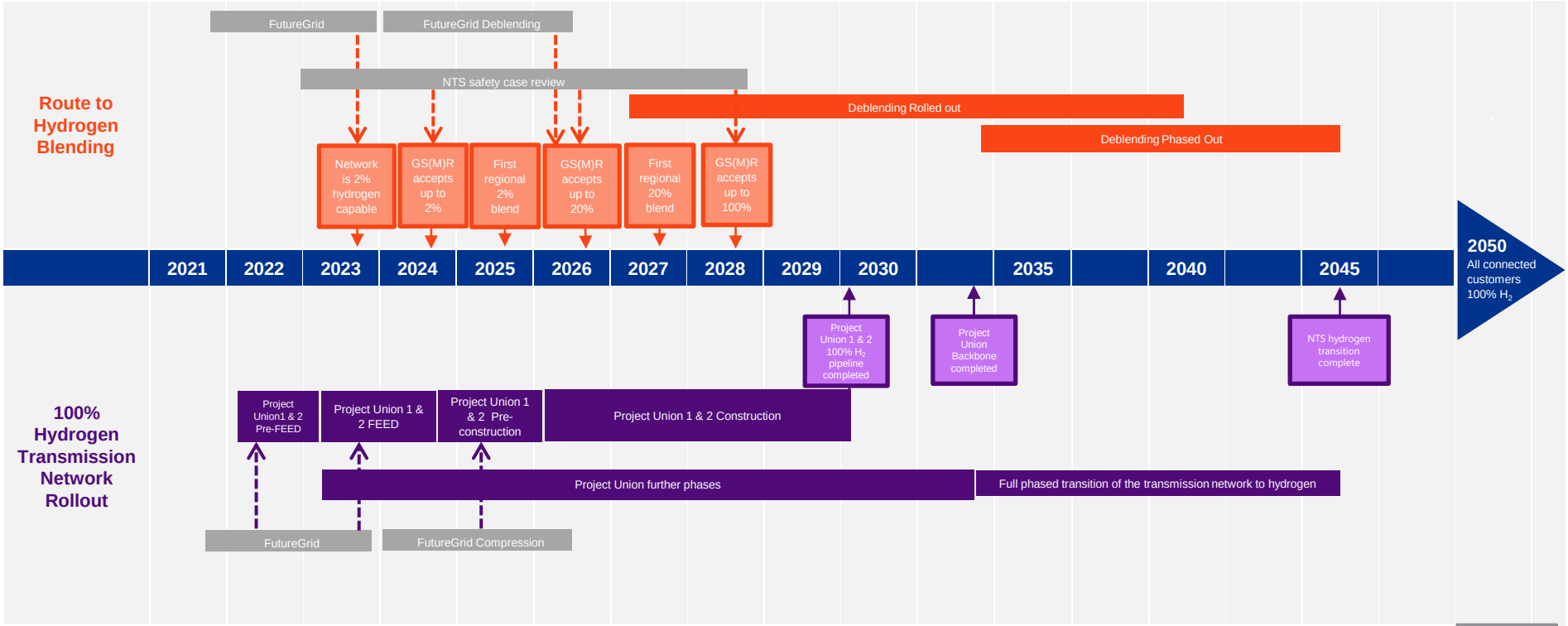
Dual Pathway to a hydrogen NTS: hydrogen blending and rollout of 100% hydrogen pipeline connections

Delivering a blend of hydrogen across the NTS in parallel to a strategic rollout of 100% transmission pipeline sections



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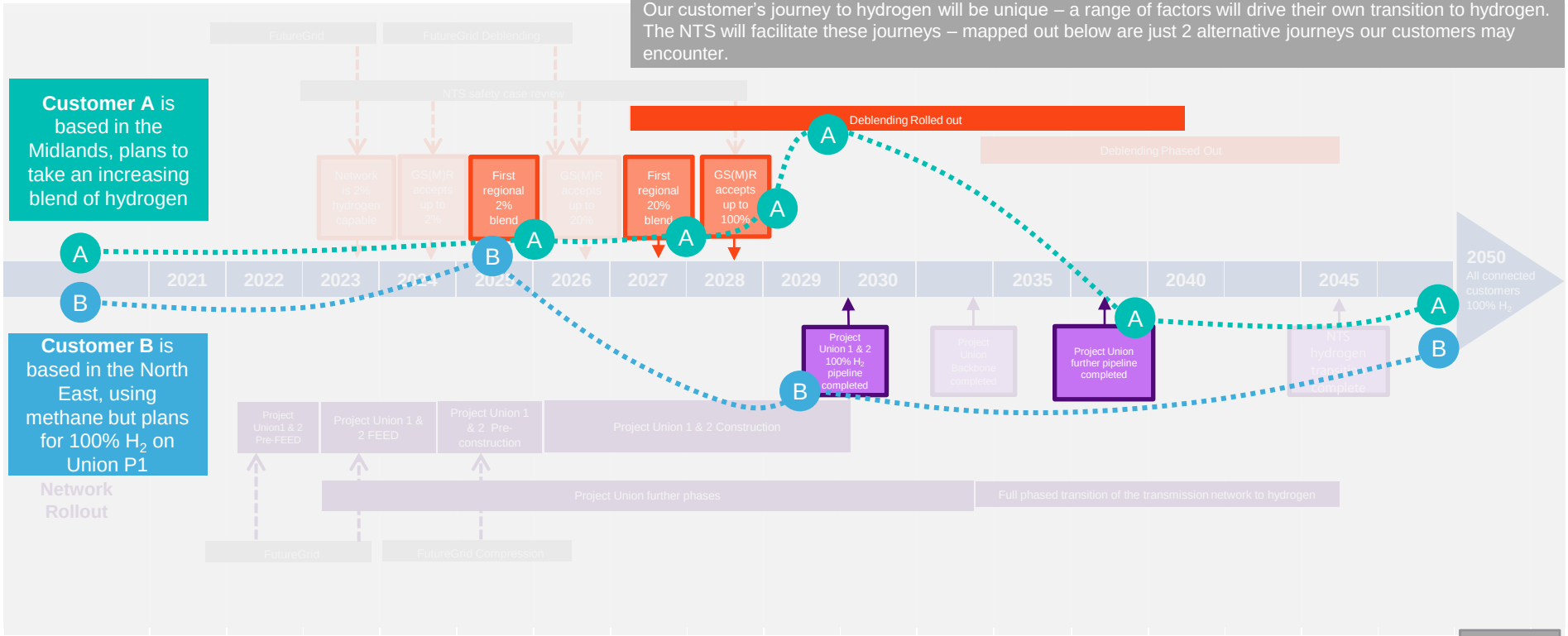
Dual Pathway to a hydrogen NTS: hydrogen blending and rollout of 100% hydrogen pipeline connections

Delivering a blend of hydrogen across the NTS in parallel to a strategic rollout of 100% transmission pipeline sections

Our customer's journey to hydrogen will be unique – a range of factors will drive their own transition to hydrogen. The NTS will facilitate these journeys – mapped out below are just 2 alternative journeys our customers may encounter.

Customer A is based in the Midlands, plans to take an increasing blend of hydrogen

Customer B is based in the North East, using methane but plans for 100% H_2 on Union P1

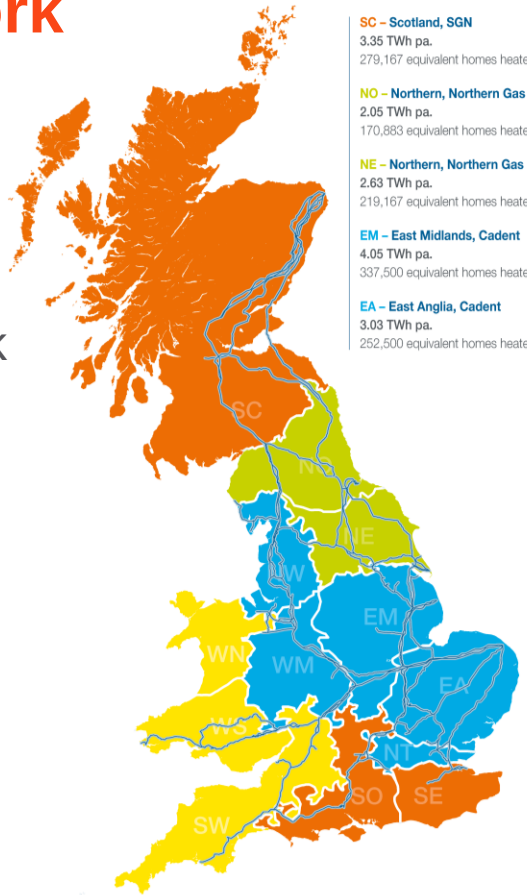


Timeline Key

Concurrent Supporting Project

Blending capacity in the UK gas network

- There is significant blending capacity across the UK network
- Transmission level blending reaches all areas of the network



National blending capacity = up to 60 TWh pa.

Distribution Network capacity = up to 35 TWh pa.

Direct NTS Capacity (excluding distribution) = up to 25 TWh pa.

SC – Scotland, SGN
3.35 TWh pa.
279,167 equivalent homes heated

NO – Northern, Northern Gas Networks
2.05 TWh pa.
170,883 equivalent homes heated

NE – Northern, Northern Gas Networks
2.63 TWh pa.
219,167 equivalent homes heated

EM – East Midlands, Cadent
4.05 TWh pa.
337,500 equivalent homes heated

EA – East Anglia, Cadent
3.03 TWh pa.
252,500 equivalent homes heated

NT – North London, Cadent
3.61 TWh pa.
300,833 equivalent homes heated

WM – West Midlands, Cadent
2.85 TWh pa.
237,500 equivalent homes heated

NW – North West, Cadent
4.84 TWh pa.
403,333 equivalent homes heated

WN – Wales North, Wales & West Utilities
0.48 TWh pa.
40,000 equivalent homes heated

WS – Wales South, Wales & West Utilities
1.58 TWh pa.
131,667 equivalent homes heated

SW – South West, Wales & West Utilities
2.20 TWh pa.
183,333 equivalent homes heated

SE – South East, SGN
3.83 TWh pa.
319,167 equivalent homes heated

SO – Southern, SGN
2.05 TWh pa.
170,833 equivalent homes heated

SGN Your gas. Our network.

Northern Gas Networks

WALES&WEST UTILITIES

Cadent Your Gas Network

nationalgrid

Government has committed to work with industry to complete testing necessary to allow up to 20% blending of hydrogen into the gas distribution grid for all homes on the gas grid.

Nationally, 60 TWh pa. of hydrogen could be blended into the grid. That's the equivalent of heating around 5 million homes*, saving around 10m tCO2 a year.

35 TWh pa. of this could be blended into the Gas Distribution Networks. Equal to heating around 3

ena energynetworks association

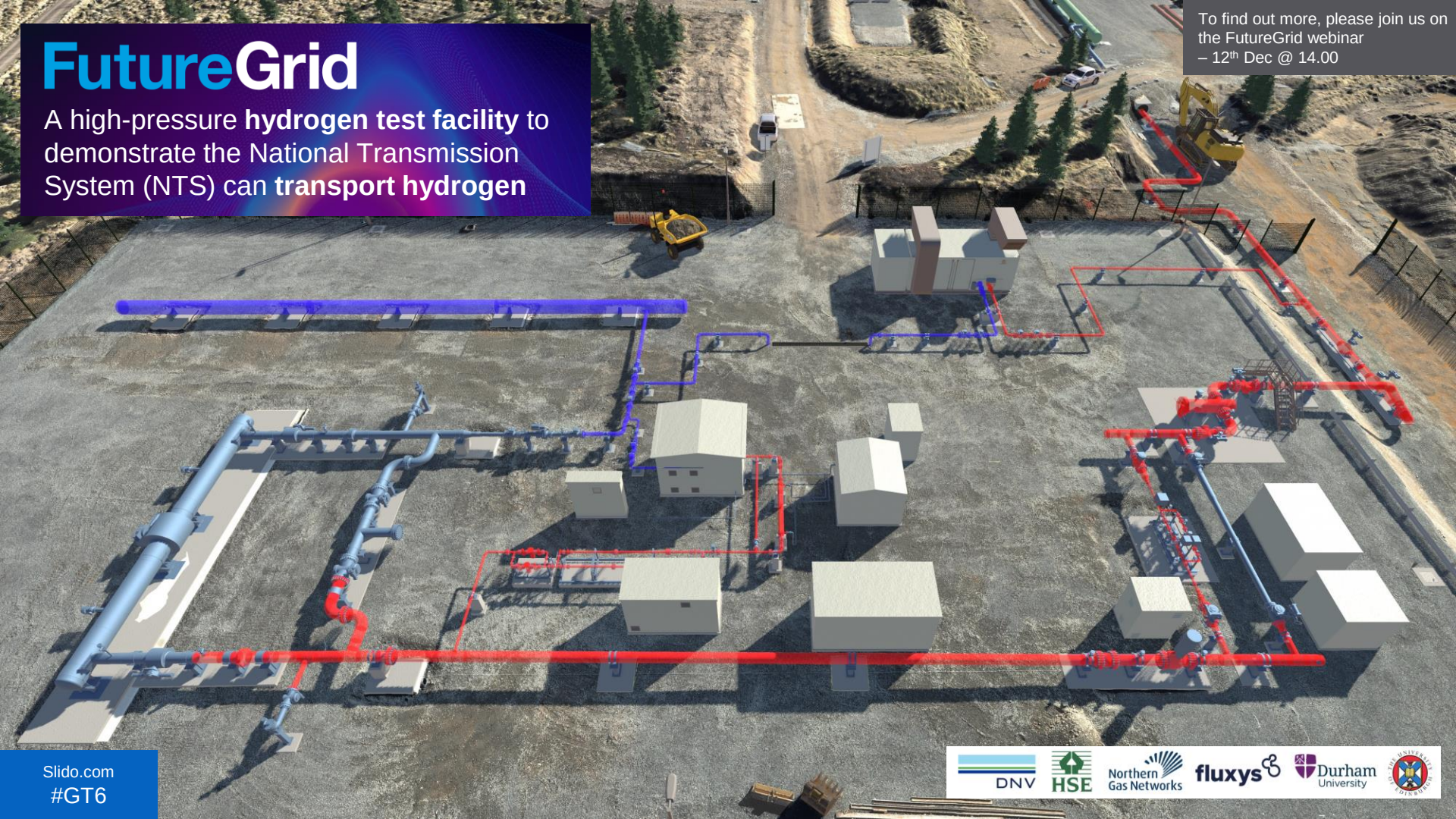
Physical Consideration

Gas Transmission

FutureGrid

A high-pressure **hydrogen test facility** to demonstrate the National Transmission System (NTS) can **transport hydrogen**

To find out more, please join us on the FutureGrid webinar – 12th Dec @ 14.00



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DNV HSE Northern Gas Networks fluxys Durham University

Phase 1 Overview

Lead nationalgrid

Project Partners DNV, HSE, Northern Gas Networks, fluxys, Durham University

Objective

FutureGrid is 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.

Duration	April 2021 – November 2023
Status	Live
Funding	NIC Project
Value	£12.7m

Offline hydrogen test facility

NTS assets of different types, sizes & material grades will be tested with 2, 5, 20 & 100% hydrogen

Testing 4 concentrations of hydrogen:

- 2%
- 5%
- 20%
- 100%

Understanding the impact on a range of key NTS assets including:

- Steel Pipeline & Bends
- Welds
- Valves
- Flow Control Valves
- Pre-Heater and Regulators
- Filters & Meter Streams

Standalone hydrogen tests

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

Conducting a range of standalone hydrogen tests to feed into the main facility:

- Materials testing
- Pipe coating testing
- Fatigue testing
- Flange testing
- Asset leak testing
- Rupture testing

NTS hydrogen safety case review

Understanding the impacts of difference concentrations of hydrogen and develop our safety standards:

- Procedure Review
- Hazard Assessment of Transmission System (HATS)
- Quantitative Risk Assessment (QRA)
- Hazardous Area Impact
- Overpressure Risk (OR)
- NGGT Safety Case

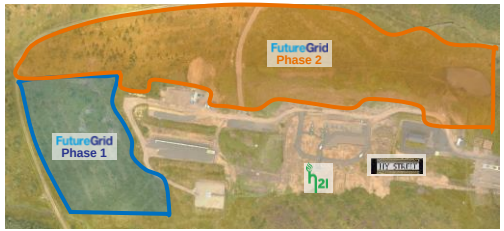
Get in Touch

FutureGrid@nationalgrid.com

nationalgrid.com/FutureGrid

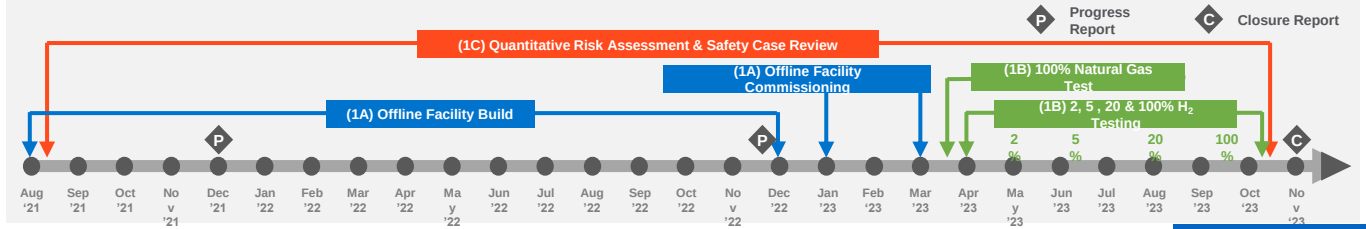
Innovation at National Grid

Location on site



Gas Transmission

FutureGrid Phase 1 Timeline



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Physical considerations for blending: 0 – 5%

Energy content	Up to a 3.4% reduction in energy
Safety	No significant change
Material properties	Hydrogen embrittlement can significantly effect material properties from very low concentrations, <1%
Compression	No significant change
Thermal characteristics	No significant change
Leakage	No significant change
Other	No significant change

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Physical considerations for blending: 5 – 20%

Energy content	Up to a 13.4% reduction in energy
Safety	Increase in size of hazardous areas Slight reduction in ignition energy
Material properties	Significant effects on material properties. Effect at 10% is almost as substantial as at 100%. TD/1 supplement considers >10% to be equivalent to 100%
Compression	Small modifications required Slight reduction in efficiency Slightly higher NOx emissions
Thermal characteristics	Much higher JT coefficient, heating requirements increased
Leakage	Slight increase in leak rate for larger leaks
Other	No significant changes expected Emissions reduced by up to 19.3%

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Physical considerations for blending: 20 – 50%

Energy content	Up to a 33% reduction in energy
Safety	Significant increase in size of hazardous areas Significant reduction in ignition energy Change in gas group - IIB
Material properties	Significant effects on material properties.
Compression	Significant modifications required Substantial reduction in efficiency Higher NOx emissions
Thermal characteristics	Higher JT coefficient, heating requirements increased
Leakage	Increase in leak rate for larger leaks Small increase in leak rate for smaller leaks
Other	Increased risk of vibration Emissions reduced by up to 47%

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Physical considerations for blending: 100%

Energy content	68% reduction in energy content
Safety	Large increase in size of hazardous areas Large reduction in ignition energy Change in gas group - IIC
Material properties	Significant effects on material properties.
Compression	Major modifications or new compressors required
Thermal characteristics	Negative JT Coefficient, pre-heat can be removed
Leakage	Substantial increase in leak rate for larger leaks Small increase in leak rate for smaller leaks
Other	Increased risk of vibration

Commercial and market considerations

Gas Transmission

Britain's Hydrogen Blending Delivery Plan- Published January 2022

Target 2023 Timeline:

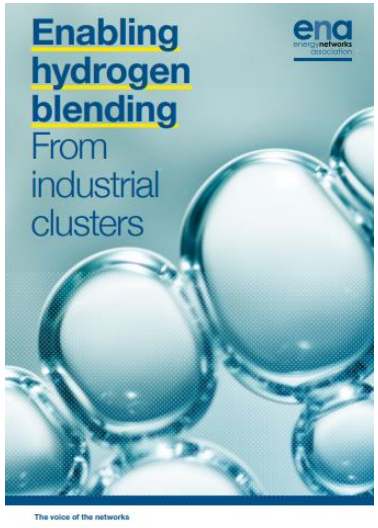
Target driven timeline, created to align with the government strategy.

Sustained Progress Timeline:

Steady progress delivering the requisite market and system change to enable network blending by 2025

Pillar	2021		2022				2023				2024			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Primary Legislation	Legislative Position (inc. CBA)													
Regulation (Billing)			Informal		Formal									
Licence	Informal Process							Formal						
Code (UNC)	Informal Process							Formal						
Safety (GS(M)R)					Formal									

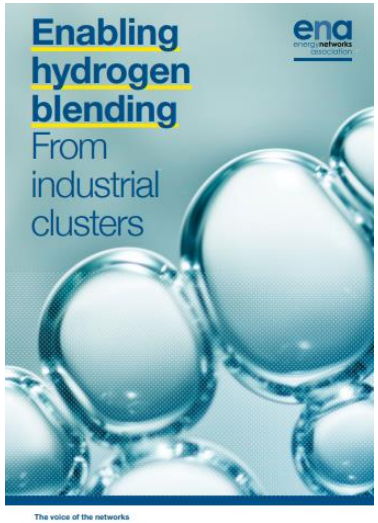
Enabling Hydrogen Blending From Industrial Clusters



- This report outlined a first review of the **current market framework principles** and was commissioned by the gas transporters as part of the Gas Goes Green work programme
- The aim was to develop a **gas transporters view** on how to facilitate Hydrogen blending across the networks.

System Operation | Balancing | Trading | Gas Quality | Capacity | Charging | Connections

Enabling Hydrogen Blending From Industrial Clusters



Key takeaways:

- Hydrogen blending can be done in a pragmatic way, with only **limited changes to the existing framework.**

- While the nature of blending at each entry point may differ slightly, in general the changes required to commercial and regulatory frameworks are the same, implying that they are **low regret**.

The current market principles have been reviewed and key areas that will require changes to enable blending into the NTS have been identified.

From within these five market principle areas the below framework and policy functions necessary for blending are now being explored.

System Operation

- Responsibilities for sensitive Users
- Manage blend volumes

Capacity

- Hydrogen blending Access

Charging

- Billing methodology adjustments
- Funding

Connections

- Coordination of injection locations
- Additional assessments for connection applications

Gas Quality

- Determination of entry conditions

Decarbonisation is key driver for developing hydrogen production

There is a range of hydrogen products:

Each product has different levels of emissions associated to them:

Blue hydrogen Natural gas reformation with Carbon Capture Usage and Storage

Green hydrogen Electrolysis of water, powered by wind energy

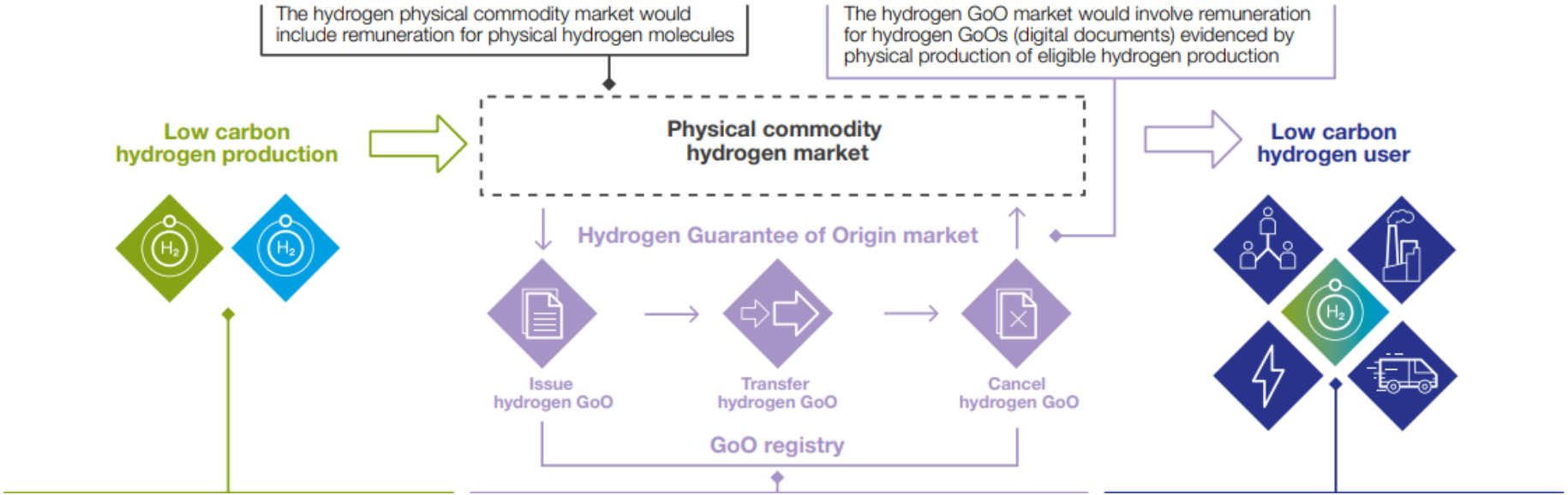
Yellow hydrogen Electrolysis of water, powered by solar energy

Pink hydrogen Nuclear power driven hydrogen production

But we cannot distinguish between different gas products within a pipeline system:

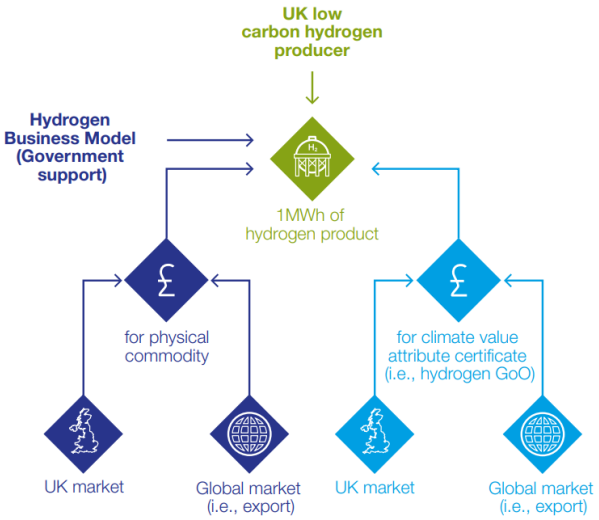
It will be essential for market participants to be able to disclose the climate value of different hydrogen products

This can be achieved through a market mechanism, such as a Guarantee of Origin (GoO) scheme:



A GoO scheme could provide a critical commercial incentive to enable hydrogen blending, benefitting:

Hydrogen producers:



Hydrogen transporters:

- ✓ Enable virtual trade ahead of physical change
- ✓ Connect hydrogen producers to consumers

Hydrogen consumers:

- ✓ Raise awareness on low carbon hydrogen products
- ✓ Enable consumers to indicate preference for specific low carbon hydrogen products
- ✓ Verify claims of hydrogen use and demonstrate commitment to decarbonise.
- ✓ Enable businesses to verify claims of hydrogen use, using GoOs to evidence carbon reduction goals

Hydrogen Gas Market Plan Guarantee of Origin report

Guarantee of Origin podcast

Summary

- **Two timelines** for blending that are driven by primary legislation change
- As part of the Gas Goes Green Programme, we are working with the Distribution networks on the strategy for **UNC changes**
- There is **strong evidence supporting blending on the NTS** and more will be generated over the coming years
- A robust **hydrogen GoO scheme** could provide a **critical commercial incentive** to blend low carbon hydrogen into the UK's existing gas networks.

Quick poll

Do you believe blending is needed at a Transmission level?

Questions

Quick Results

Do you believe blending is needed at a Transmission level?

Webinar Programme

https://ngrid.com/3ESgN1t

Event Name		Date / Time	Presenters
Keynote speech	Watch again		Jon Butterworth, CEO
Facilitating Commercial & Regulatory Change	Watch again		Ian Radley, System Operations Director
Sustainable Construction	Watch again		Mark Lissimore, Construction Director
Accessing Energy Data	Watch again		Mark Lissimore, Construction Director
Operating the Network	Watch again		Ian Radley, System Operations Director
Transitioning to 100%	Sign Up	Tuesday 6th December @ 11:00	Martin Cook, Commercial Director
Hydrogen Regulatory Framework	Sign Up	Wednesday 7th December @ 12:00	Tony Nixon, Regulation Director
Monitoring and Mitigating Methane Emissions	Sign Up	Thursday 8th December @ 13:00	Steven Vallender, Asset Director
Future of Heat	Sign Up	Friday 9th December @ 13:30	Tony Green, Hydrogen Director
FutureGrid - Progress Report	Sign Up	Monday 12th December @ 14:00	Tony Green, Hydrogen Director
Innovation	Sign Up	Tuesday 13th December @ 13:00	Tony Green, Hydrogen Director
Driving a Positive Environmental & Community Impact	Sign Up	Wednesday 14th December @ 10:00	Jake Tudge, Corporate Affairs Director

What next?

You will receive the recording and material from today’s session

If you have any further questions or would like to discuss anything specific please get in touch with Jennifer.Pemberton@nationalgrid.com

Feedback is important to us, therefore if you have not already taken part, we would like to put you forward for a survey

Thank you for joining us

Gas Transmission