Transitioning to 100% hydrogen

We will start at 11.02 to allow participants to finish previous meetings and join the call

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#GT7

Gas Transmission

Welcome and Opening

Thank you for joining us today

Martin Cook

Chief Commercial Officer

Slido.com
#GT7

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*

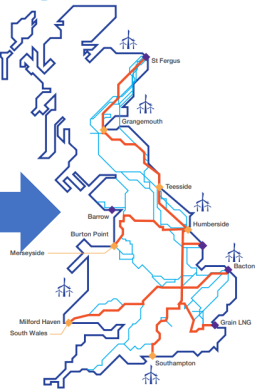
Data

- *Data specification*
- *CNI*
- *Environmental impact*

Asset Management

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

ProjectUnion



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*

Who will be speaking?

Matthew Sumerling
Hydrogen Development Engineer

Ed Gilford
Hydrogen Development Engineer

Derek Radburn
Hydrogen Development Engineer

Suki Ferris
Hydrogen Market Strategy Lead

Jennifer Pemberton
Stakeholder Strategy Manager

Logistics

Should last for approximately about 60 min

Questions and polling via slido.com #GT7

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. Project Union

2. Regional Projects

3. Gas Markets Plan

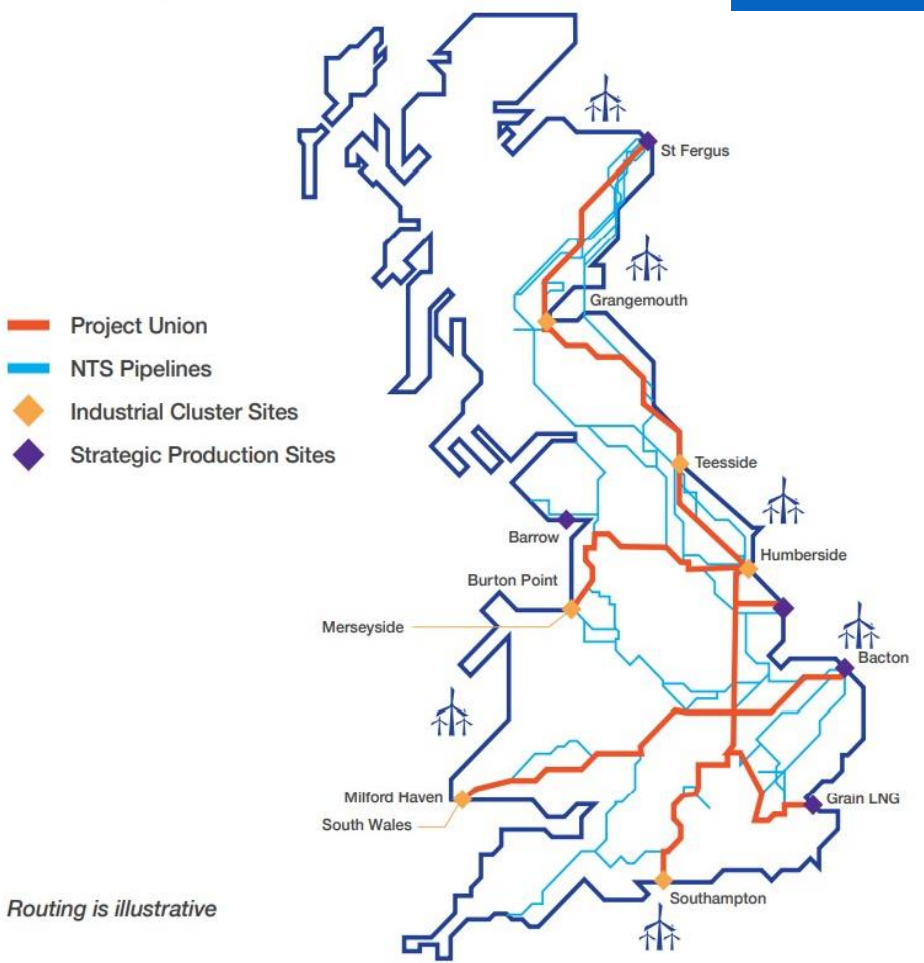
4. Questions

Project Union

Gas Transmission

ProjectUnion Overview

- **UK hydrogen "backbone"** repurposing 1,500 ~ 2,000 km of existing assets to **100% hydrogen**
- Enable hydrogen transmission whilst **ensuring security of methane supply** for consumers
- Aligned to **green and blue hydrogen developments and CCUS** clusters
- **Connect** hydrogen production, demand, storage, and export centres
- **Decarbonise heavy industry and power** and create optionality for heat and transport



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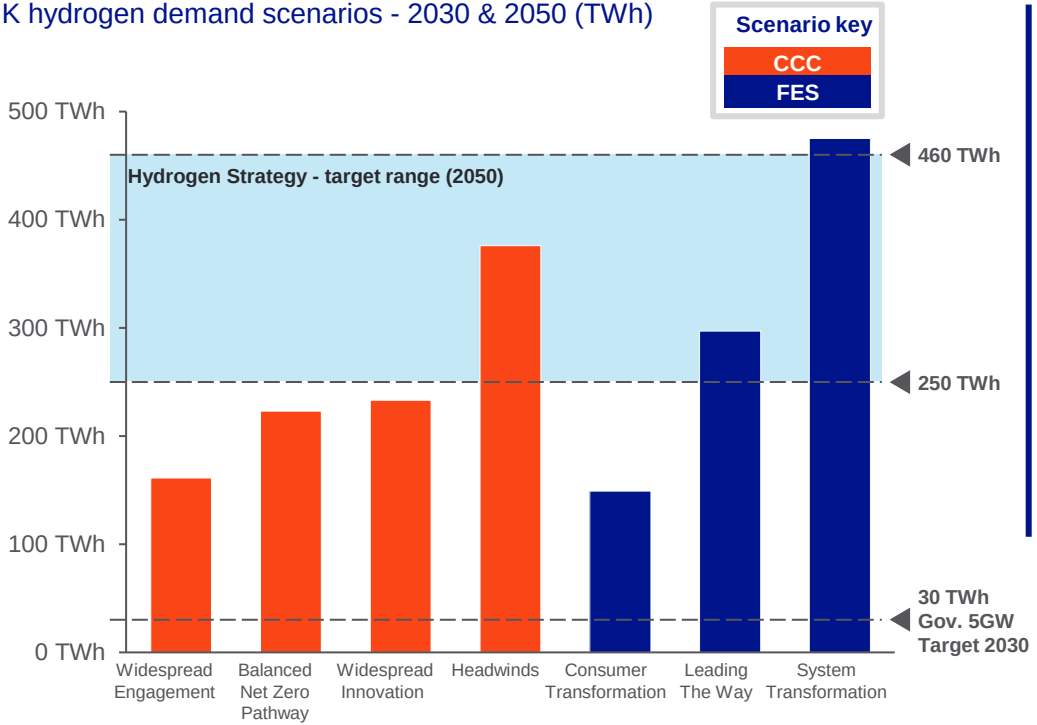
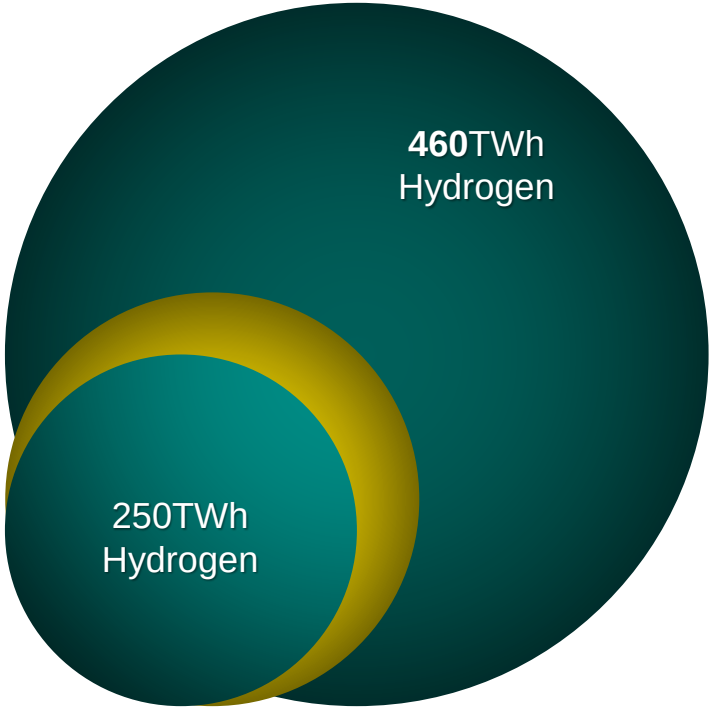
ProjectUnion

We cannot reach net zero without hydrogen

UK hydrogen demand scenarios - 2030 & 2050 (TWh)





857TWh per year of natural gas through NTS today

Note: CCC (Committee on Climate Change); Sixth Carbon Budget (2020); FES (Future Energy Scenarios), FES 2021 FES Steady Progression scenario is discarded as it does not reach net zero

ProjectUnion benefits

- Decarbonisation of industry & power
- Energy storage & resilience
- Connectivity & efficiency
- Market Coupling
- Contribute to Energy Security
- Levelling up & job creation
- Global leader in green innovation
- Flexibility & optionality
- Consumer-centric
- Export opportunities

11

ProjectUnion Delivery roadmap

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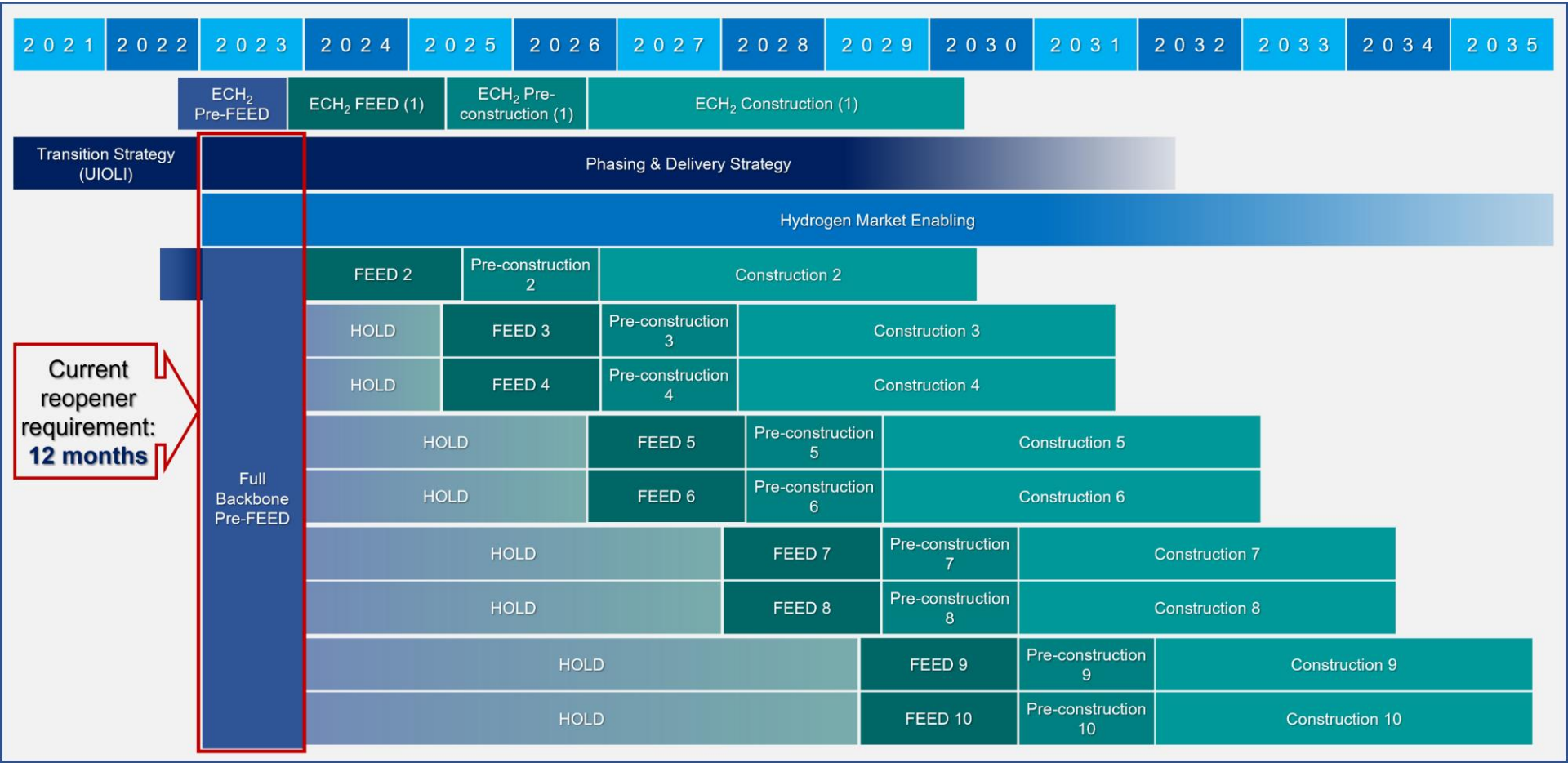


ProjectUnion Potential Routes (illustrative)

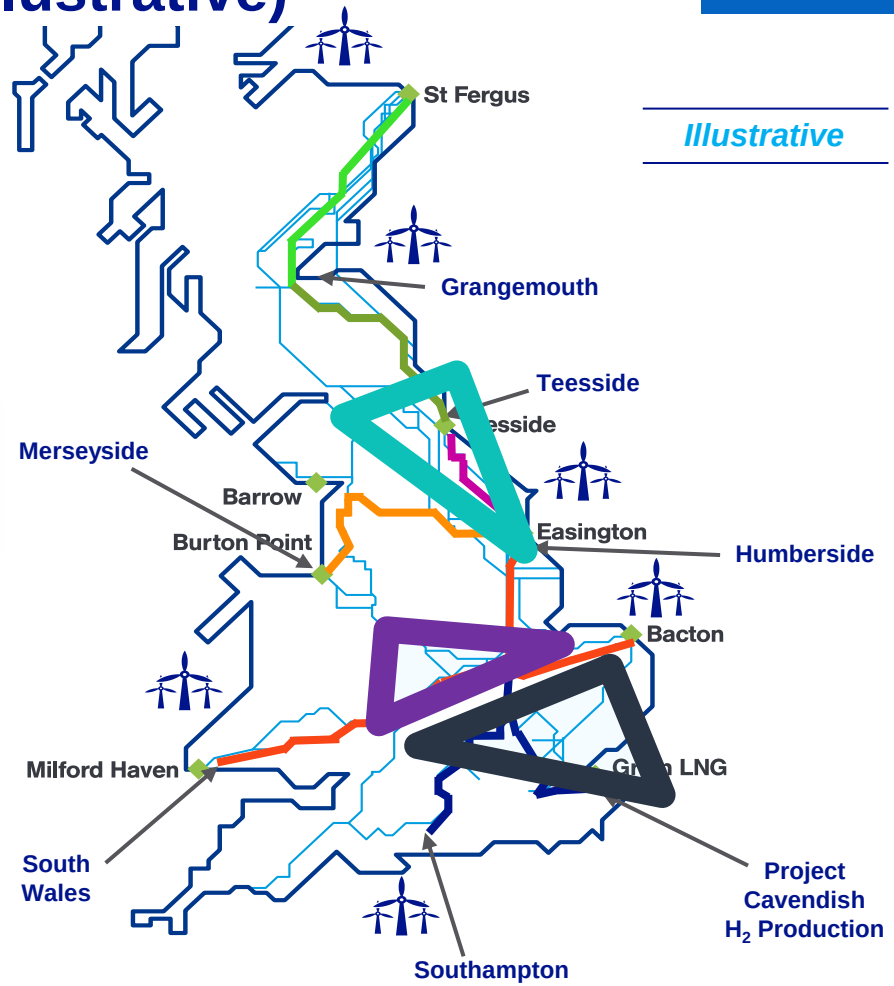
- St. Fergus – Grangemouth
- Teesside – Grangemouth
- Humber –Teesside
- Humber – Merseyside
- South Wales – Bacton – Humber
- Southampton- Cavendish

Sequencing and timing of the pipeline conversions will be determined by the outputs of the Feasibility Phase Network Analysis and Stakeholder Engagement

East Coast Hydrogen

Hydrogen Valley

capital H_2



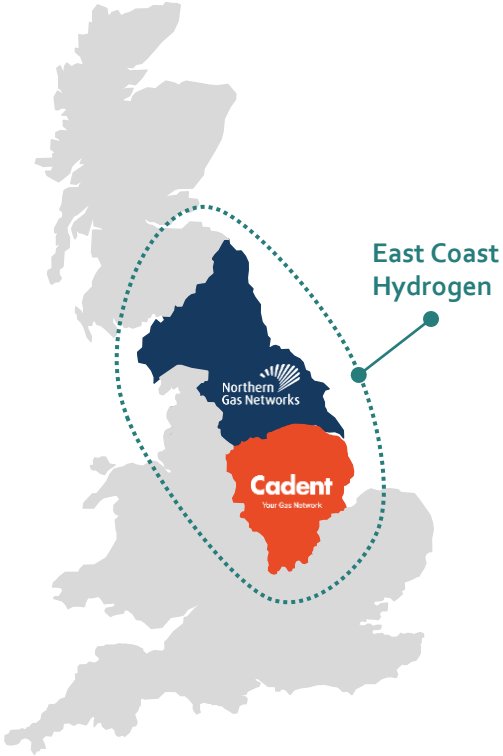
Regional transitions

Gas Transmission

East Coast Hydrogen

East Coast Hydrogen (ECH2) is crucial to meeting the UK's Net Zero target by 2050

East Coast Hydrogen



- Hydrogen produced in the Humber and Teesside regions will be connected utilising new and existing network infrastructure
- The hydrogen network will power industrial decarbonisation, supply transport, and heat homes and businesses within the region
- Interconnection with production facilities, salt cavern storage, and neighbouring hydrogen schemes will enhance the system resilience
- The hydrogen network will grow into urban centres such as North, West and South Yorkshire, Cumbria, the North West and Midlands
- This 15 year major UK infrastructure project will bring together gas networks and large industrial players to drive the hydrogen economy

Gas Transmission

Phase 1 of East Coast Hydrogen delivered a Feasibility Study

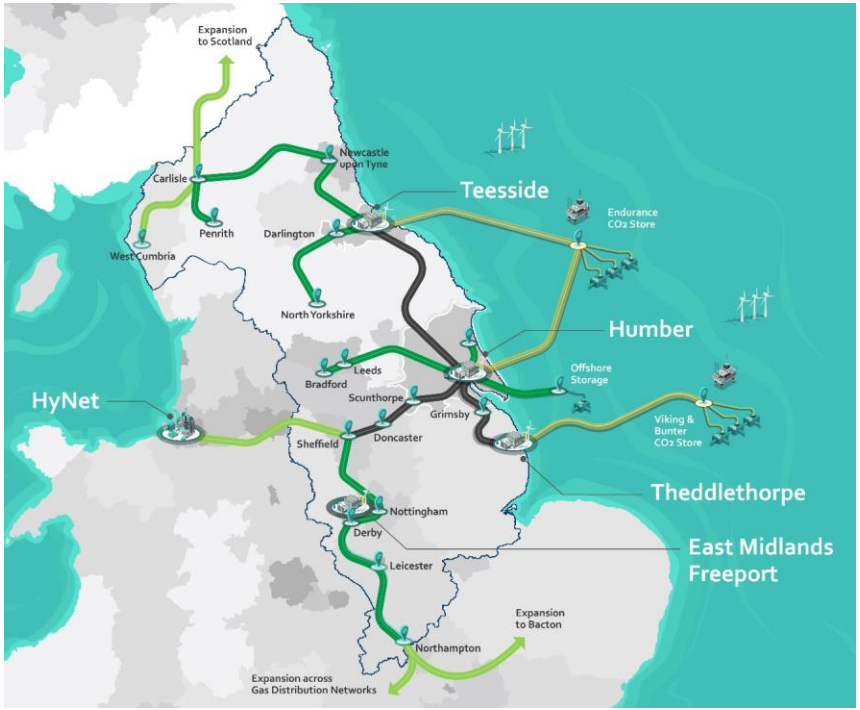
East Coast Hydrogen is a 15 year programme that will be carried out in multiple discrete phases to decarbonise industrial processes and domestic heating in the East Coast region.

Phase 1
(2022 – 2026)
Completion of Pre-FEED, FEED Study and development of East Coast Cluster infrastructure

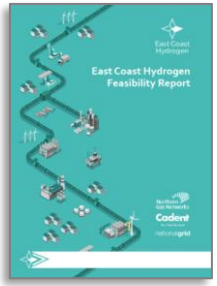
Phase 2
(2024 – 2030)
Connection of Humber and Teesside clusters, and growth into Yorkshire and East Midlands

Phase 3
(2028 – 2037)
Expansion from the industrial Clusters into Northern urban areas and the Midlands

Phase 4
(2032+)
Connection of the network into further regions and future growth opportunities



The outcomes of Phase 1 were delivered in the form of a Feasibility Study report and a Launch Event as the House of Commons



East Coast Hydrogen Feasibility Study

Published November 2021

Key outcome: East Coast Hydrogen has the potential to decarbonise up to 39,000 industrial and commercial sites, up to 4.4 million homes, and avoid up to 20MtCO2 /year in direct emissions.

Huge potential for hydrogen production and industrial and residential decarbonisation in the region

East Coast Hydrogen

01	02	03
		
Interconnectivity	Industrial decarbonisation	Domestic decarbonisation
Over 7GW Current planned hydrogen production by 2030 in the East Coast Hydrogen region	**Up to 39,000** Commercial and industrial sites supplied with low carbon heating and process fuel	**Up to 4.4 million** Domestic properties switched to a low carbon heating solution
~10TWh Planned hydrogen storage capacity in the East Coast Hydrogen region	**Up to 11MtCO$_2$** Annual avoided commercial and industrial emissions by fuel switching from gas to hydrogen	**Up to 9MtCO$_2$** Annual avoided domestic emissions from switching to a hydrogen gas supply

There are 51 ECH2 Consortium members who have signed Letters of Support or provided hydrogen forecasts

East Coast Hydrogen

The Consortium Group is an exclusive group made up of a wide range of stakeholders across the hydrogen value chain. To date, a total of 51 industry and local stakeholders have signed Letters of Support for the East Coast Hydrogen Programme.

Cross-value chain
Hydrogen value chain participants

bp, VPI, EQUANS, SIEMENS energy, EAST COAST CLUSTER, equinor, DelpHYnus, kellas MIDSTREAM

Upstream
Hydrogen production

uniper, BOC A Member of The Linde Group, CPH2 CLEAN POWER HYDROGEN, ITM POWER Energy Storage | Clean Fuel, ECO ENERGY WORLD, PHILLIPS 66

Downstream
Sector-specific utilisation

AGGREGATE INDUSTRIES, TRITON POWER, LIBERTY, KNAUF, FORTERRA, GUARDIAN GLASS See what's possible, Boots, sembcorp, Lenzing Innovative by nature, SOFIDEL, TOYOTA, BritishSugar, 2 sisters Food Group, ALSTOM mobility by nature, Singleton Birch, Vaillant, Enertek International, PEPSICO, CRANSWICK plc Great British Taste, Loughborough University, H+H PARTNERS IN WALL BUILDING, Samworth Brothers QUALITY FOODS

Midstream
Transportation and storage

centrica storage, Navigator

Local stakeholders
Regional and local partners

MIDLANDS ENGINE, TEES VALLEY COMBINED AUTHORITY, Greater Lincolnshire Local Enterprise Partnership, North East Local Enterprise Partnership, D2N2 Derby Derbyshire Nottingham Nottinghamshire, EAST MIDLANDS DEVELOPMENT COMPANY, West Yorkshire Combined Authority, CATCH

Gas Transmission

www.capitalhydrogen.co.uk

Capital Hydrogen – Working in partnership to deliver hydrogen for London, the East of England and the South East

capital H_2

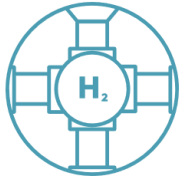
What is the Capital Hydrogen Programme?

Capital Hydrogen is a 15-20 year programme that will allow a transition from a natural gas network to a hydrogen network in London, the East of England and the South East.

The Feasibility Study Identified:

How much hydrogen may be needed by the whole region over the next 30 years

Where the hydrogen will be produced and stored



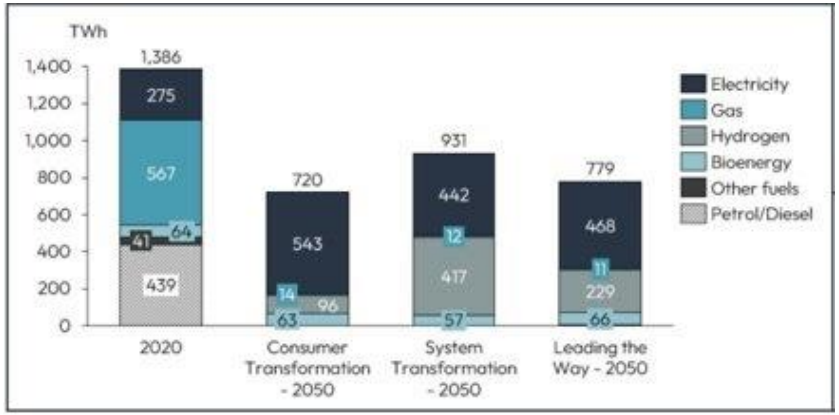
How it will be transported to where it is needed

The economic benefits of the programme

Cadent Your Gas Network | Gas Transmission and Metering | SGN

Gas Transmission

Why do we need the Capital Hydrogen Programme?



- The gas networks have a key role to play in establishing hydrogen
- Over 90 local authorities in this region have declared a Climate Emergency
- London's Net Zero Target is 2030
- Greater London Authority (GLA) has asked for gas networks' help in achieving the 'Accelerated Green' Scenario to the Net Zero by 2030 goal

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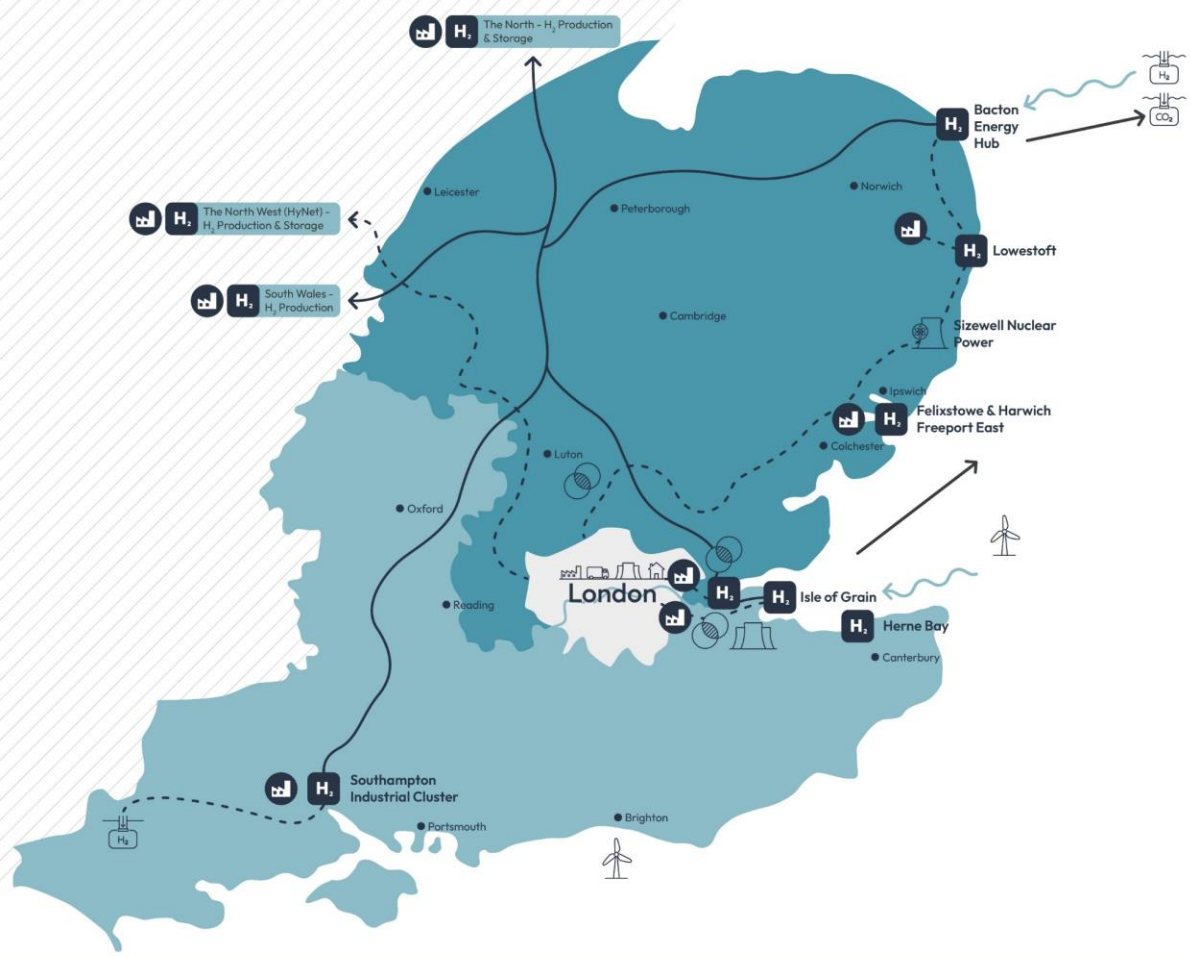


Pipes

- H_2 transmission pipes - repurposed
- H_2 transmission pipes - new or repurposed

Shipping Routes

- CO_2 Exports
- H_2 Imports

Services

- Hydrogen Production
- Industrial Hydrogen Use Cluster
- Blending H_2 with natural gas into the gas network
- Underground H_2 Storage
- Underwater H_2 Storage
- Potential H_2 Production from Wind Energy
- Potential H_2 Production from Nuclear Power
- Power Station
- Underwater CO_2 Storage

Regions

- Cadent
- SGN
- Rest of the UK

Benefits of Capital Hydrogen

www.hydrogenvalley.co.uk

Hydrogen Valley Programme

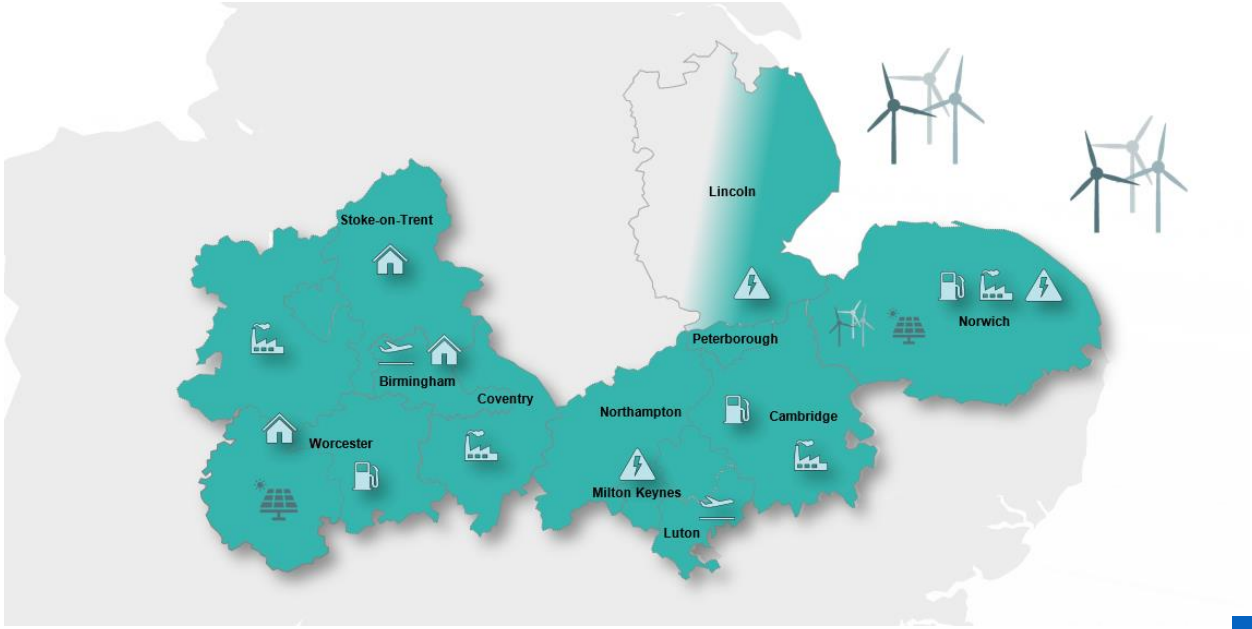
Hydrogen Valley

Collaborative regional project between Gas Transmission & Cadent

Gas Transmission and Metering

Cadent
Your Gas Network

Guidehouse
Outwit *Complexity*



The Hydrogen Valley programme assesses the feasibility of the development of a hydrogen economy in the region

Phase 1: Establish fundamentals (June-Aug 2022)

Forecasting of future hydrogen demand and supply potential, identification of hydrogen hotspots in the region

Phase 2: Infrastructure feasibility (June-Sept 2022)

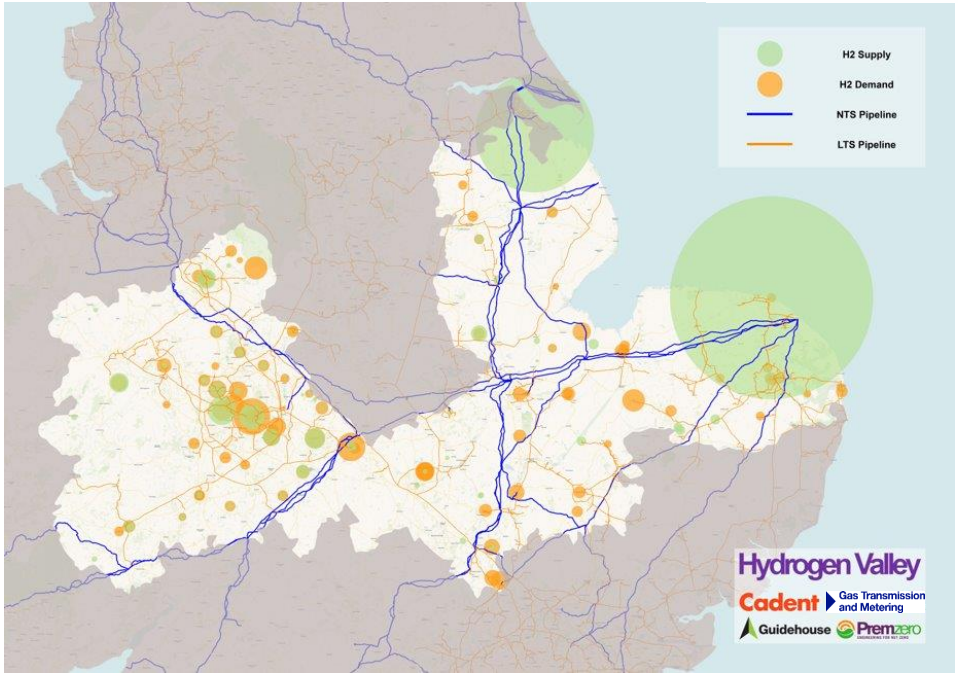
Assessment of capability of existing network, definition of need for new pipelines, development of different scenarios and costs

Phase 3: Transition roadmap (Aug-Dec 2022)

Quantification of socio-economic benefits, development of investible propositions

Phase 4: Programme launch (March 2023)

Launch event at Westminster to gather key stakeholders, share project findings, and establish a clear call to action

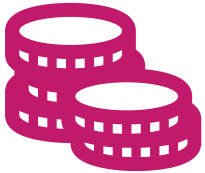


Benefits of the Hydrogen Valley

Hydrogen Valley

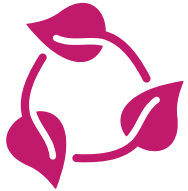
Job creation

There is the potential for up to **25,000 jobs to be supported and a further 9,000 created** in the UK hydrogen economy within the Hydrogen Valley



Investment in the Midlands

This programme can attract up to **£28 billion of private capital investment** in transforming the region to a net-zero central belt in England



Rapid decarbonisation

By accelerating the transition, Hydrogen Valley can deliver **25% of the emission reductions** needed to reach net-zero in the region

Increased energy security

The Hydrogen Valley will **drastically reduce the region's reliance on fossil fuels** with up to 48TWh of clean hydrogen produced for the region

Next Steps

East Coast Hydrogen

Consortium

Transmission Pre-FEED

Hydrogen Valley

Consortium

Launch

Transmission Pre-FEED

www.hydrogenvalley.co.uk

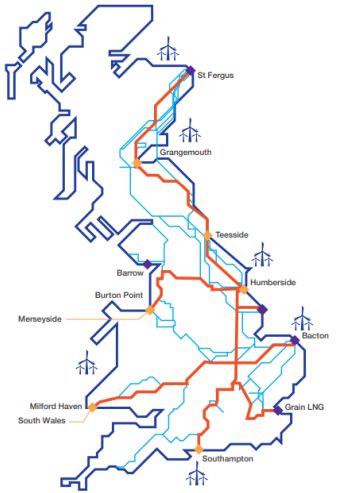
capital H_2

Consortium

Transmission Pre-FEED

www.capitalhydrogen.co.uk

ProjectUnion



Hydrogen Gas Market Plan (GMaP)

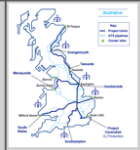
Gas Transmission

Hydrogen Gas Market Plan (GMaP):

How may the gas commercial framework need to evolve to accommodate Project Union?

Problem statement:

- The development of Project Union will need a **commercial framework** to ensure **consumer value** throughout the hydrogen transition.
- However, there is **uncertainty** on how the existing gas sector market design and commercial frameworks may need to **evolve** to accommodate the development of Project Union.

Hydrogen network **market phases**	Isolated cluster phase	Connected clusters phase	Regional expansion phase	Hydrogen phase
	Hydrogen networks limited to within clusters, no connectivity – minimal H2 penetration	*Limited use in clusters with small scale hydrogen grids, limited transportation between clusters – low H2 penetration*	*Regional hydrogen grids emerge, more transportation between clusters/regions – medium H2 penetration*	*Dispersed hydrogen production and consumption with large scale grids – high H2 penetration*
Hydrogen network **industry projects**	 Track 1 clusters: HyNet, East Coast Cluster. Scottish Govt support for Project Acorn	 Project Union, NGGT project exploring the development of a UK hydrogen backbone through repurposing the NTS to join industrial clusters around the country	 East Coast Hydrogen explores connection of repurposed and new build H2 gas grids expanding from clusters and Project Union.	
Hydrogen network **market analysis**	HMG UK Hydrogen Strategy hydrogen economy roadmap			
	H2 UNC Mods (760, 800, 799)	NGGT hydrogen network regulatory framework (market phases, cost allocation, investment decision making in times of uncertainty)		
		EU hydrogen and decarbonised gas package		
Hydrogen GMaP proposal:		This H2 GMaP project builds on existing H2 network projects to explore how the existing gas commercial framework may need to evolve to accommodate Project Union (*i.e., open access 100% H2 networks*).		

How may the gas commercial framework need to evolve to accommodate Project Union?

H2 GMaP approach & aims:

We are working in **collaboration** with an **expert industry working group** to deliver:

- Articulation of **key challenges to existing commercial frameworks** from development of Project Union.
- **Exploration of commercial framework solution options**, considering near-term and longer-term phases of Project Union.

Output:

- **Final report Q2 2023**
- **Further refinement of commercial framework options**

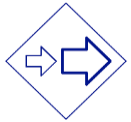
Components of the gas commercial framework that may need to evolve to accommodate Project Union

System Operation

- GNCC
- Residual balancer
- Security of Supply
- Shrinkage provider
- System planning
- Access to competitive supply sources
- Affordability

Balancing

- Nominations
- Notifications
- Storage
- Incentives
- Metering
- Short-term demand forecasting
- Data
- Constraint management
- Shrinkage

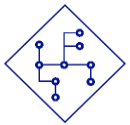


Trading

- National Balancing Point (NBP)
- On the day Commodity Market (OCM)
- Over the Counter Trades (OTC)
- Exchanges

Gas Quality

- Gas quality standard
- Entry requirements
- Exit requirements



Capacity

- Baseline capacity
- Incremental capacity
- Constraint management
- (NTS) Capacity auctions
- (NTS) Planning and Advanced Reservation of Capacity Agreement (PARCA)
- (Interconnection Points) Capacity Allocation Mechanism (CAM)

Charging

- Settlement process
- Consumer billing
- (NTS) Commodity charges
- (NTS) Capacity charges

Connections

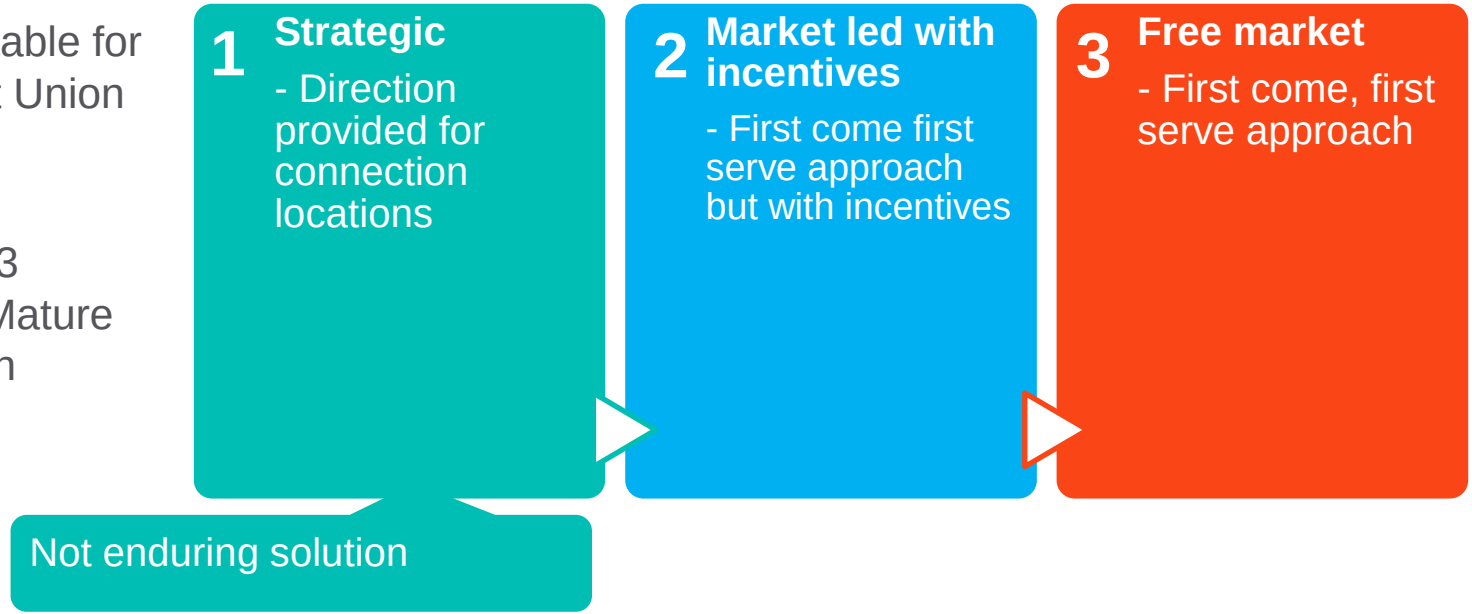
- Connection application
- Planning and Advanced Reservation of Capacity Agreement (PARCA)
- (Interconnection Point) Capacity Allocation Mechanism (CAM)

Great Britain has a mature gas market that has been designed in the context of delivering natural gas to end users. Considering a transition to a low carbon hydrogen future, the gas industry will need to prepare for detailed commercial framework changes as well as changes to roles and responsibilities of market players.

Case study on Connections: Solution Options

Greater need to consider approach to ensuring hydrogen supply can meet demand:

- Option 1 suitable for initial Project Union pipeline(s)
- Options 2 & 3 suitable for Mature Project Union Backbone



Key GT messages on the gas market framework for the BEIS Hydrogen Transportation and Storage Business Model

- **Progress, simplicity and compatibility** is critical
- We believe the existing commercial arrangements are **suitable** but **not optimal**
- Using existing market frameworks **does not preclude movement to hydrogen specific market framework**
- Hydrogen market framework **options** could include:
  - **Develop existing market frameworks**
  - **Add hydrogen specific sections**
  - Generate **new hydrogen market frameworks**.

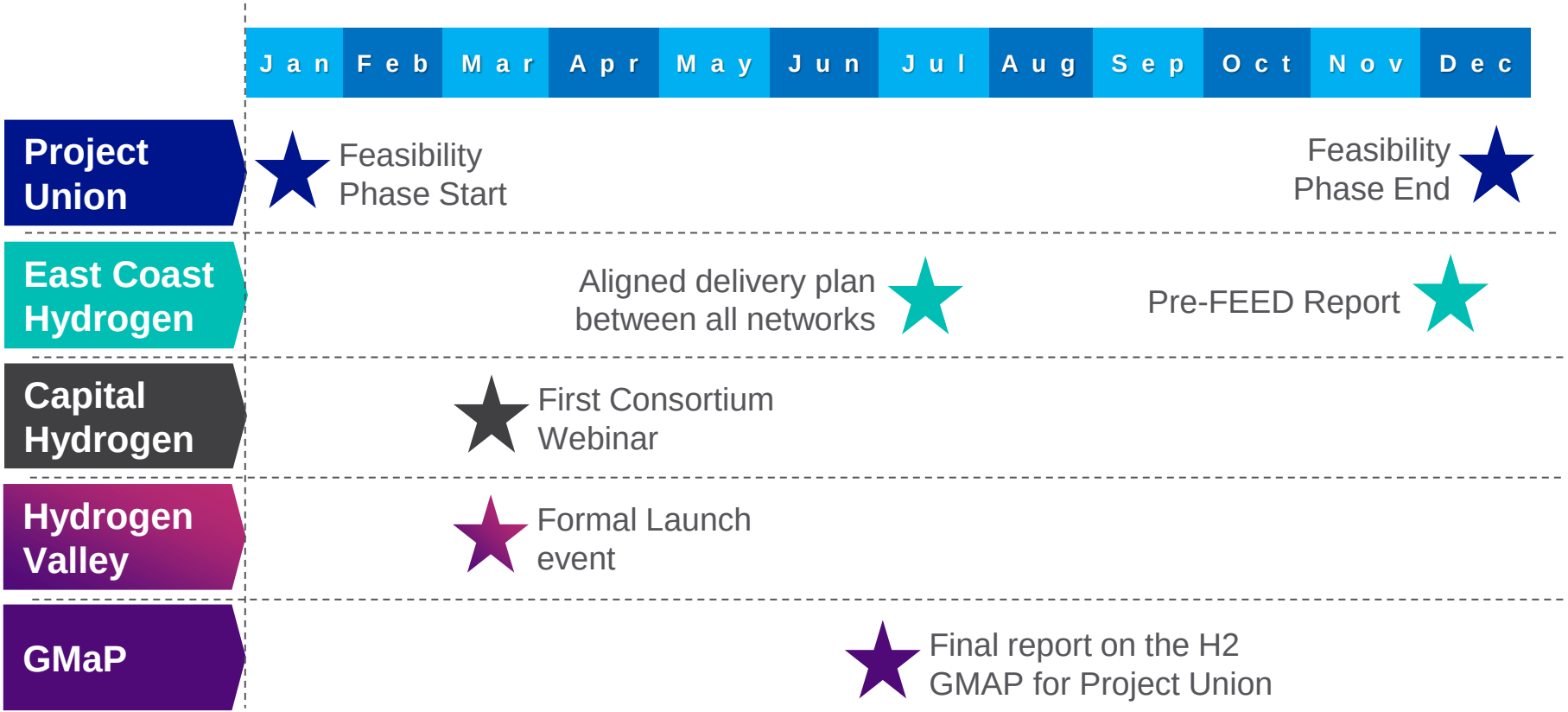
Summary and next steps

Gas Transmission

Summary

- Decarbonisation of the energy sector requires a **whole system approach**
- Hydrogen is needed as **part of all Net Zero Energy Transition scenarios**
- Project Union will **enable resilient connection** of Hydrogen Production and Storage to Demand by repurposing of Gas Transmission assets to 100% hydrogen
- Project Union will be **aligned** with **Regional Projects**
- We are on the right track, but need to **accelerate quickly** and want to **engage with our key stakeholders**

Timeline with next steps



Questions

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