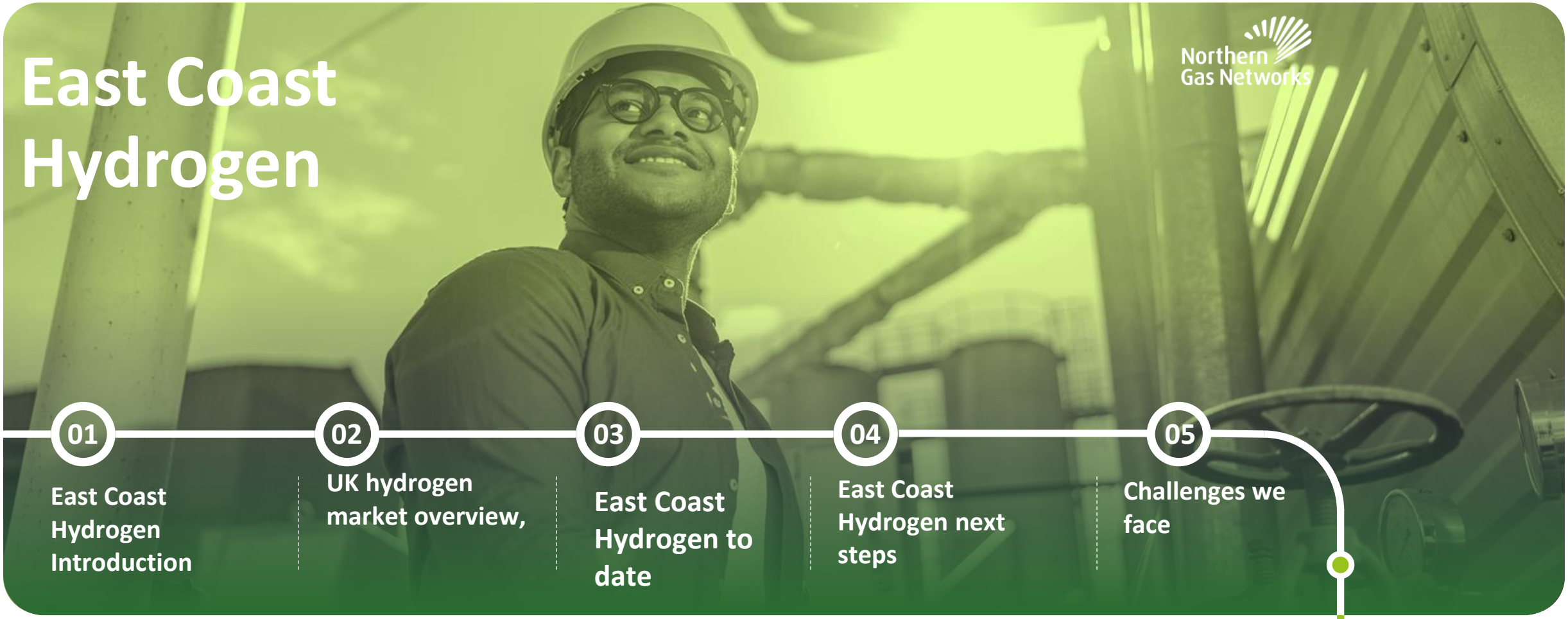
East Coast Hydrogen



Northern Gas Networks

01 East Coast Hydrogen Introduction

02 UK hydrogen market overview,

03 East Coast Hydrogen to date

04 East Coast Hydrogen next steps

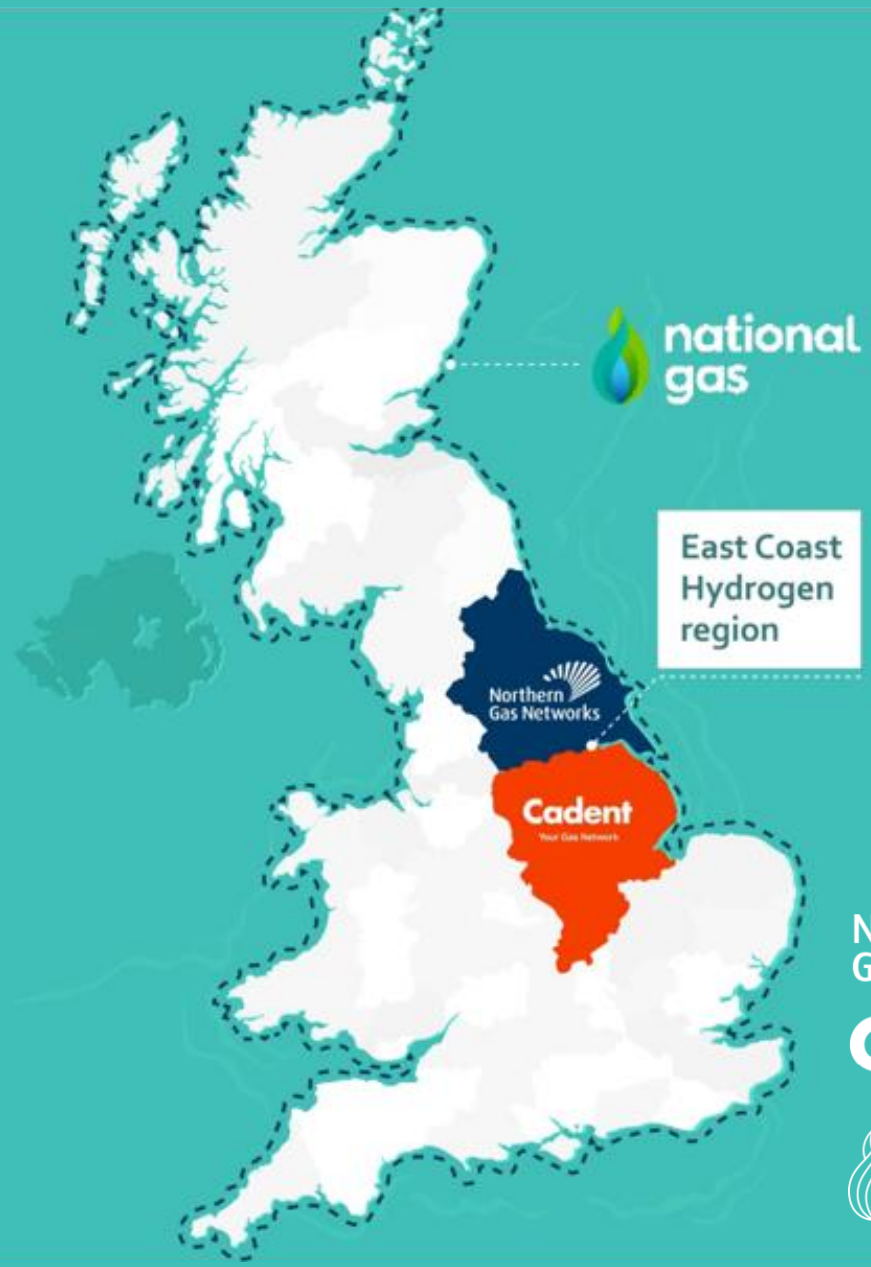
05 Challenges we face

East Coast Hydrogen

East Coast Hydrogen

A plan to connect hydrogen production and storage with industrial users in our region.

- **100% Hydrogen**
- **Industrial and Commercial Network**
- **Repurposing existing methane pipelines where possible**
- **Existing methane network maintained to all areas**



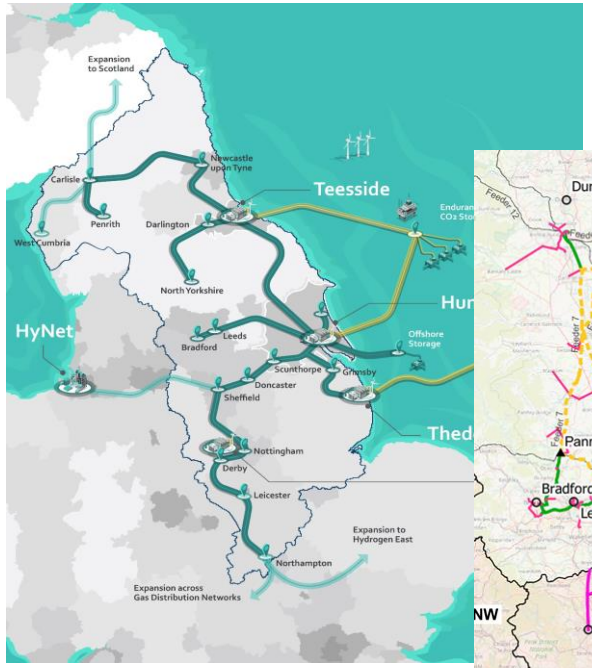
Northern Gas Networks

Cadent
Your Gas Network

national gas

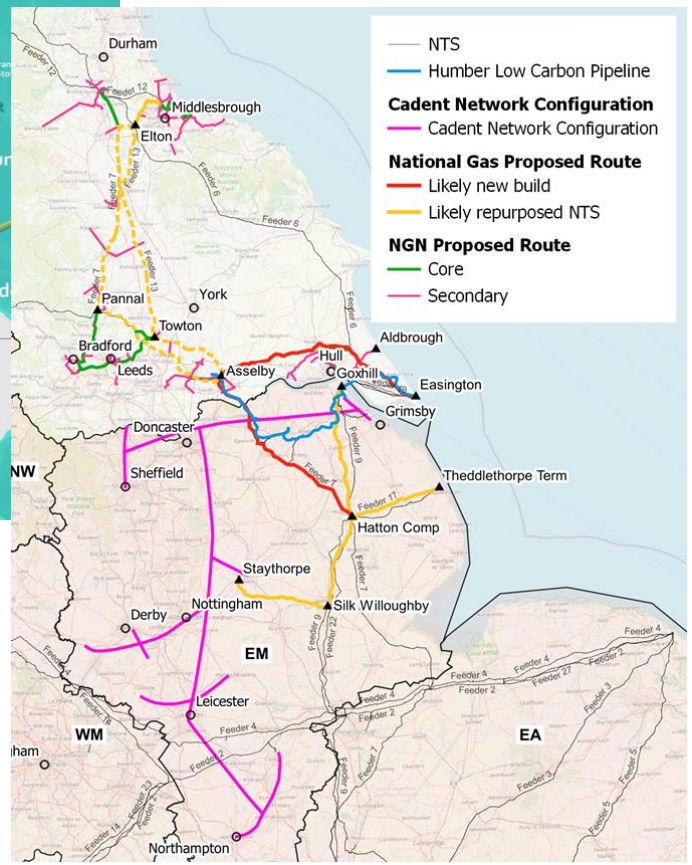
Project Phases

East Coast Hydrogen is a long-term project that will be carried out in multiple, discrete phases to decarbonise industrial processes and domestic heating in the East Coast region.



Feasibility Study

Pre-Feed Study



Phase 1 - Feasibility Study (2021)

Definition of the strategic business case for East Coast Hydrogen

Phase 2 (2022 – 2026)

Delivery Plan , **Completion of Pre-FEED**, FEED Study and hydrogen production development

Phase 3 (2026 – 2028)

Hydrogen Transport and Business model DEVEX and planning

Phase 4 (2028 – 2037)

Construction and commissioning of transmission and distribution networks

3

NGN work on ECH2 has demonstrated the strong need and significant regional support for network infrastructure to enable use of hydrogen

NGN East Coast Hydrogen Project overview

Supply 10 TWh to industry by 2037.

Connect 42 TWh of hydrogen production by 2037.

Enable 3.98 TWh of planned hydrogen storage by 2037.

Whole East Coast Hydrogen Considerations

Timeline	✓ Project is aiming to connect to its first low-carbon hydrogen customers between 2030 to 2035
Project attributes	✓ Supported over 122 stakeholders across the value chain ✓ Connects large demand centres in Teesside, Humber and the East Midlands, enabling industrial decarbonisation ✓ Building ~1840km new hydrogen network with 770 km of the existing natural gas pipeline repurposed
Economics	✓ Successfully triggered the Reopener application for further funding by Ofgem to progress into FEED studies
Other	✓ Successfully completed each network Pre-FEED studies confirming high-level technicalities and feasibility ✓ Produced a Delivery Plan report outlining the needs case

The whole of East Coast Hydrogen will enable …

Demand

Over 63 TWh/year
identified I&C, power and aviation hydrogen demand by 2037*

44%
annual I&C and power natural gas demand potentially switched to hydrogen

Up to 12 $MtCO_2$/year
avoided I&C, power, and aviation emissions

Production

Up to 83 TWh/year
current planned hydrogen production by 2037 in the East Coast region

4.4 GW
Green Hydrogen capacity is planned by 2030, meeting 88% of the UK Government targets

22 projects
provided primary data and forecasts to support network development

Storage

4 large scale sites
connected across North Humber and Teesside

Over 19%
of the UK's storage requirements (56 TWh) will be met by 2050 within the region

10.7 TWh
storage to be deployed by 2050

Source: East Coast Hydrogen, 2023 Delivery Plan report

Pre-FEED Delivery Plan

Connect hydrogen supply with hydrogen demand across multiple customers commencing with industrials fuel switching to hydrogen

Transport hydrogen through repurposed and new build pipelines to industrial users first, with further potential to supply domestic users through Town pilot

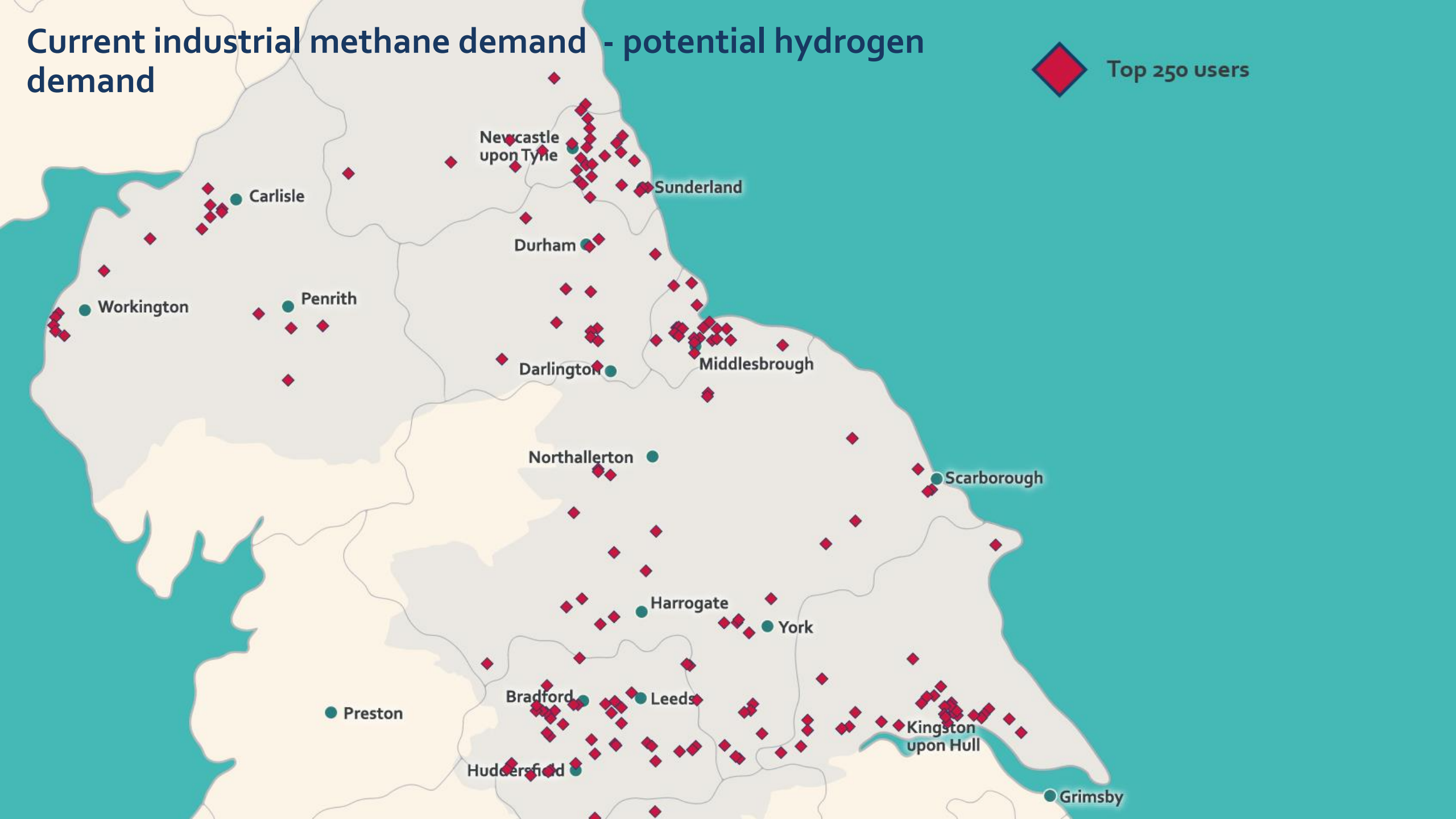
Build resilience with the interconnectivity of the Humber and Teesside industrial clusters and storage facilities across the East Coast Hydrogen region

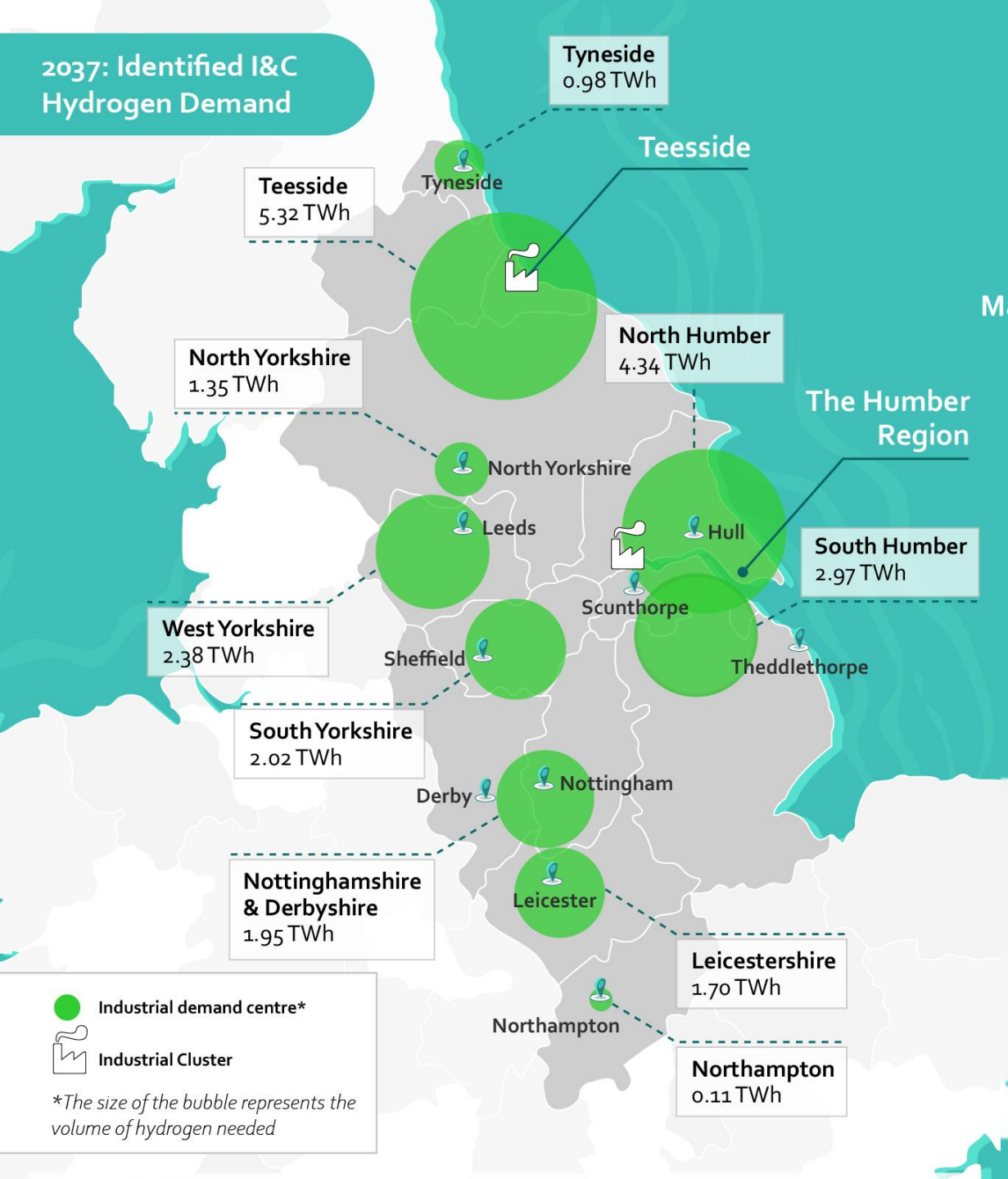
Support efficient market growth by balancing supply and demand and enabling connections across the East Coast Hydrogen region



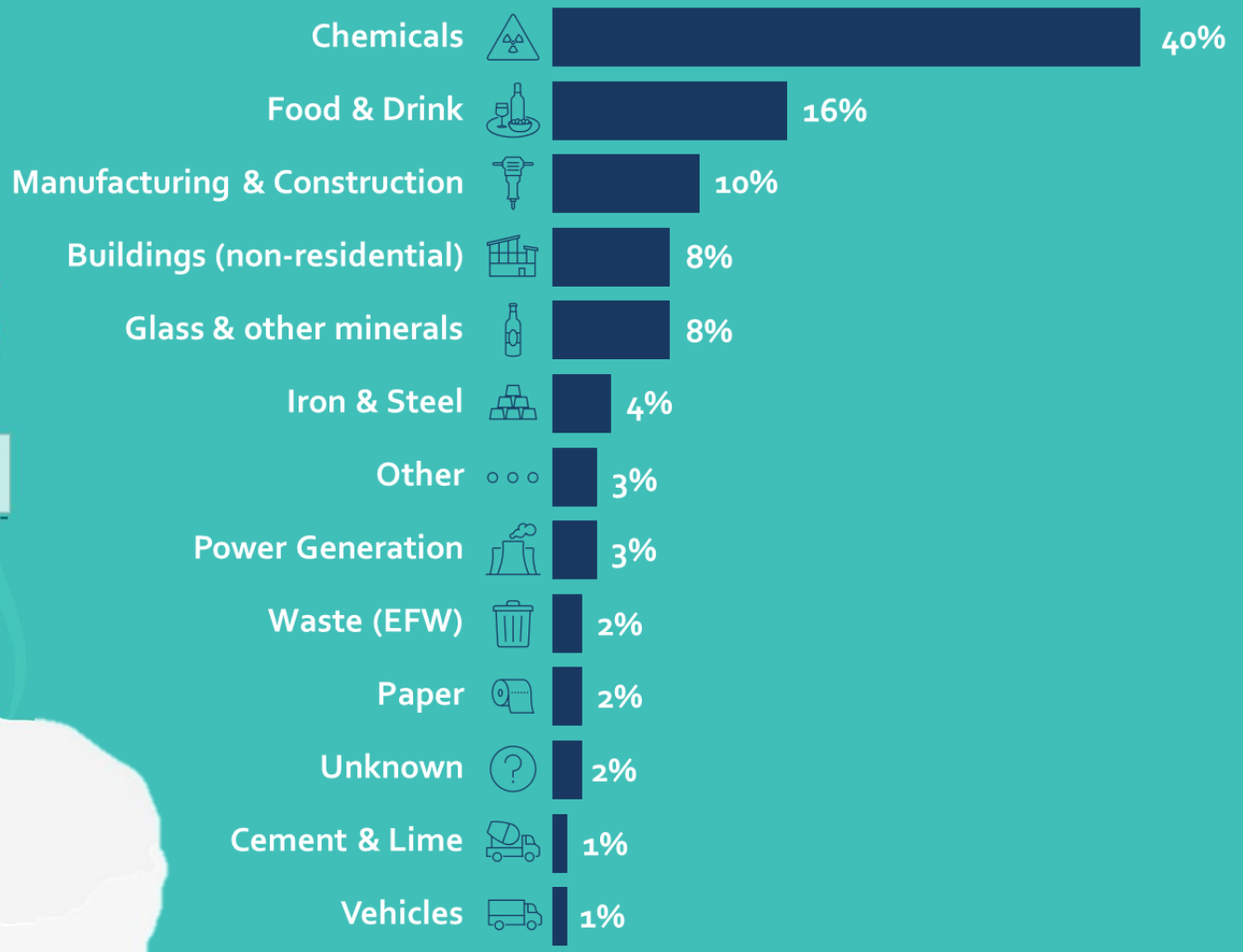
Note: Network configuration includes new build and repurposed pipelines and is indicative and subject to change

Current industrial methane demand - potential hydrogen demand





I&C demand of NG by industry





94

have become consortium members

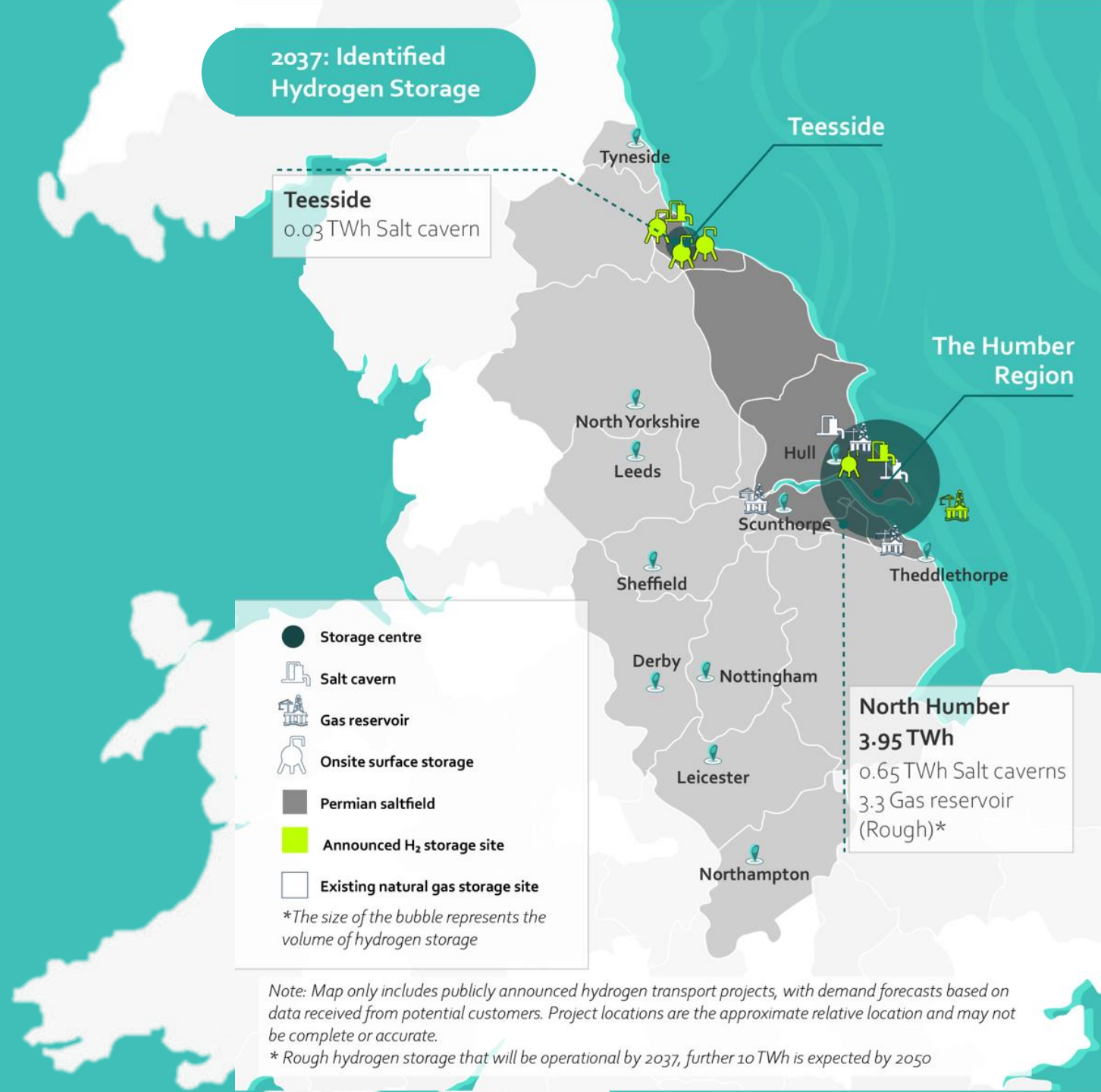
157

One-to-one introductory meetings held with I&C users of gas

In NGN's region:

3.98 TWh
of announced hydrogen storage in NGN's region.

22 – 48 TWh
of hydrogen storage potential in Salt caverns.

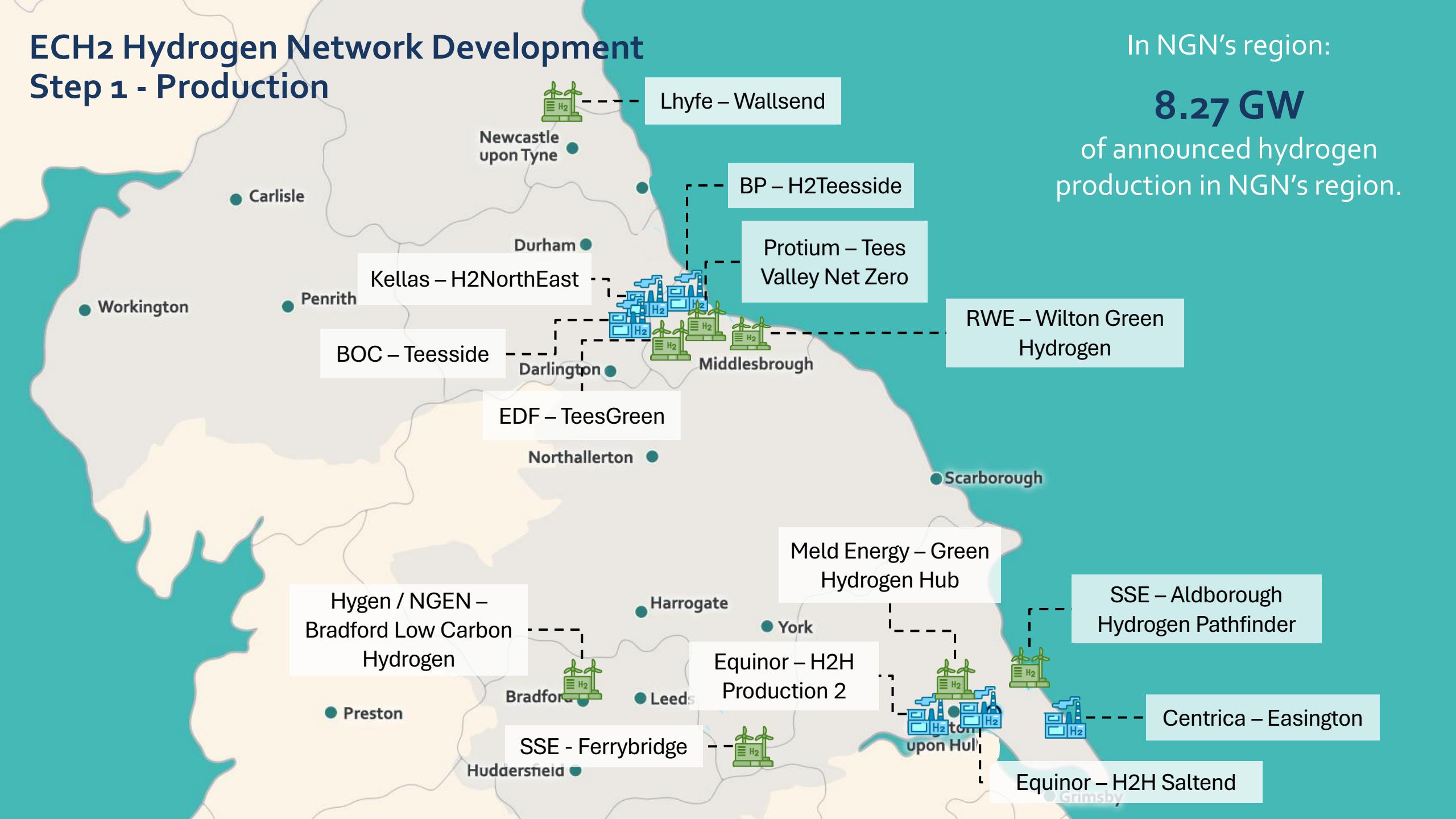


ECH2 Hydrogen Network Development
Step 1 - Production

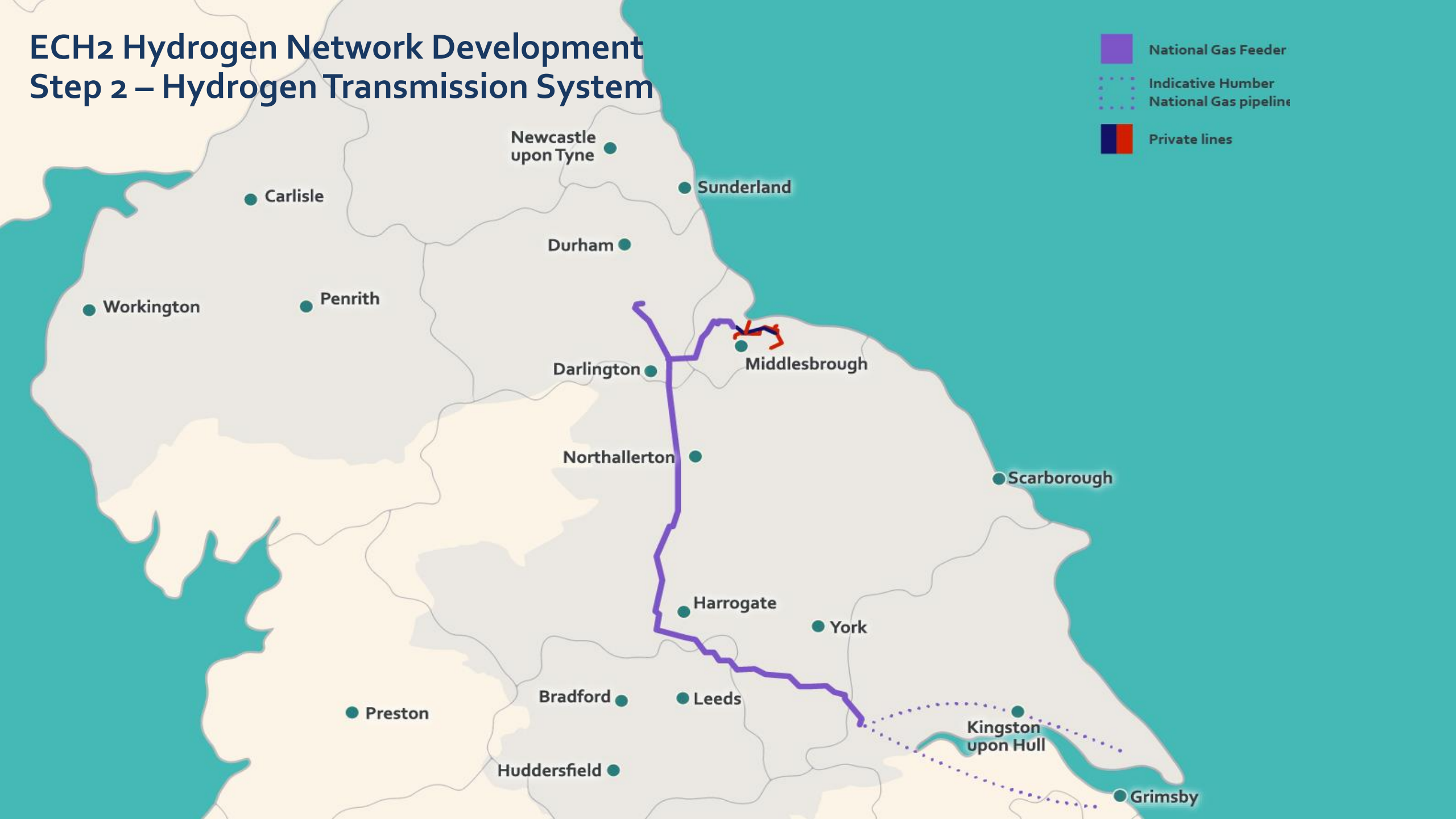
In NGN's region:

8.27 GW

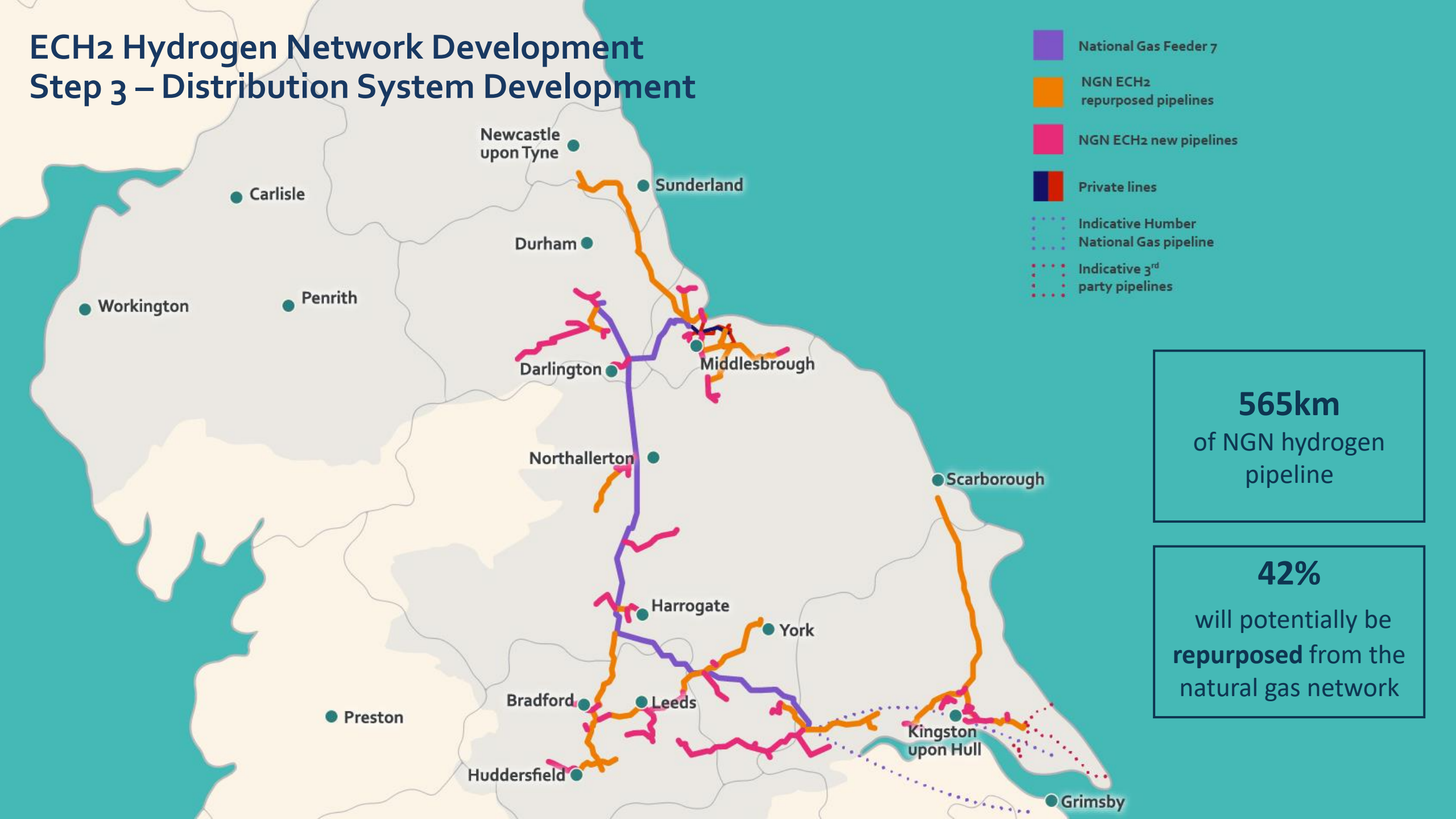
of announced hydrogen production in NGN's region.



ECH2 Hydrogen Network Development
Step 2 – Hydrogen Transmission System



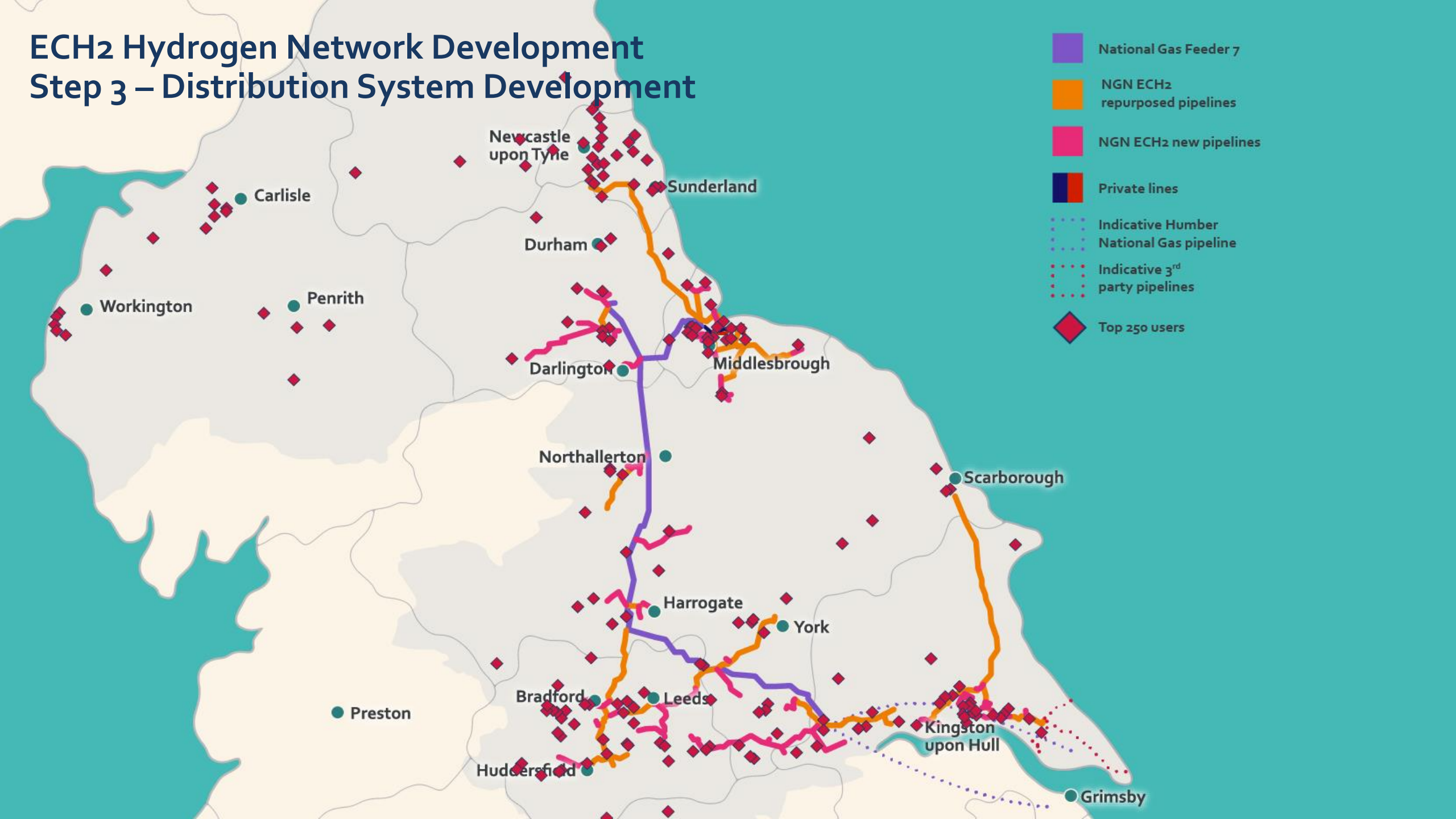
ECH2 Hydrogen Network Development
Step 3 – Distribution System Development



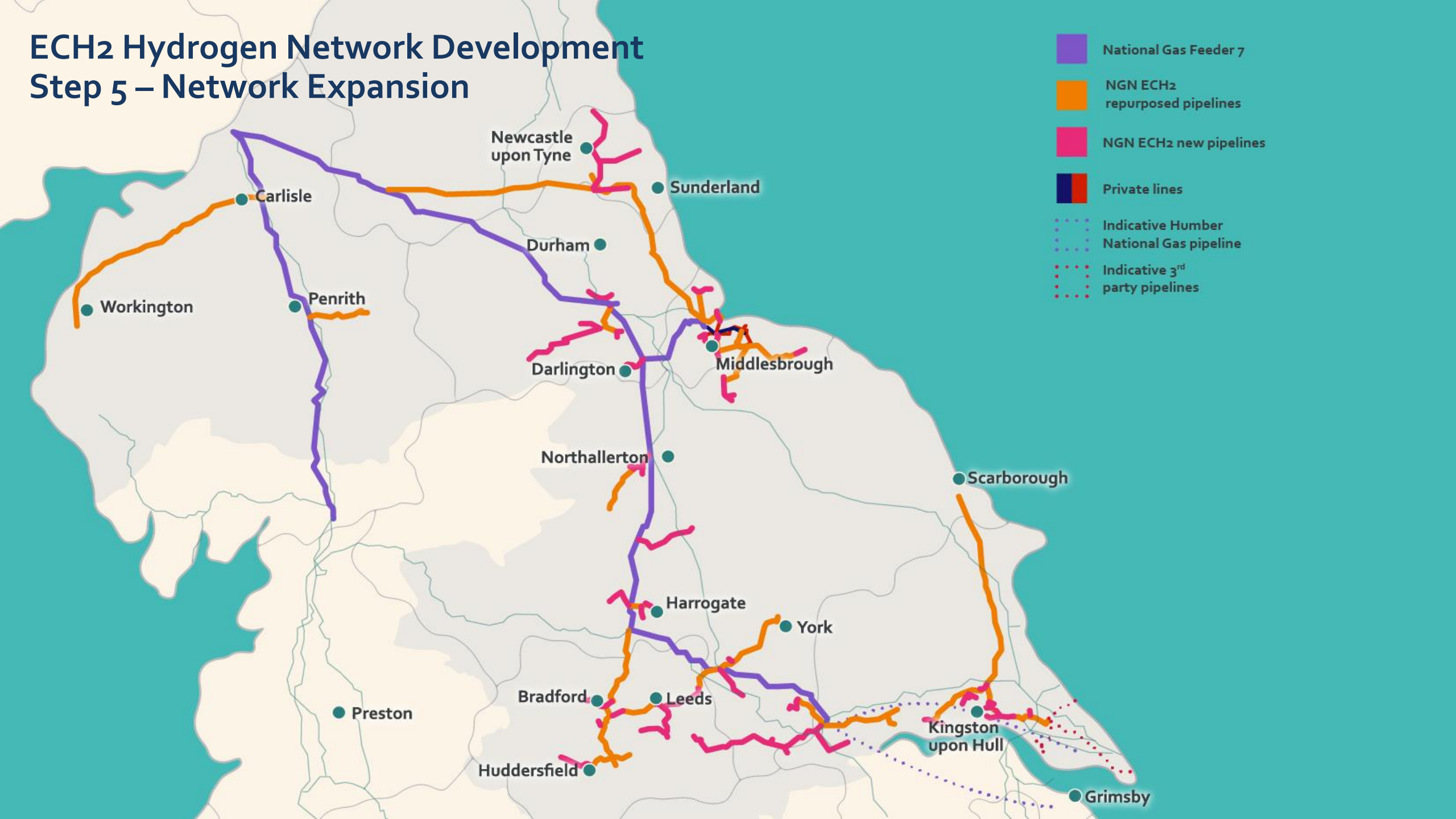
565km
of NGN hydrogen pipeline

42%
will potentially be **repurposed** from the natural gas network

ECH2 Hydrogen Network Development
Step 3 – Distribution System Development



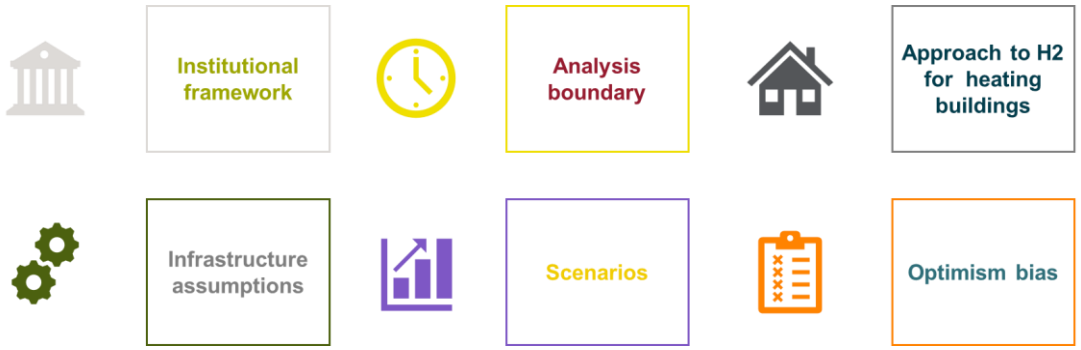
ECH2 Hydrogen Network Development
Step 5 – Network Expansion



A Cost Benefit Analysis was completed for the Re-opener submission to Ofgem for funding for a FEED

Cost-benefit Analysis

- This CBA assesses the benefit to UK society of undertaking **NGN's** network investments, relative to a counterfactual where the investments are not undertaken.
- The CBA complies with Ofgem's CBA requirements.

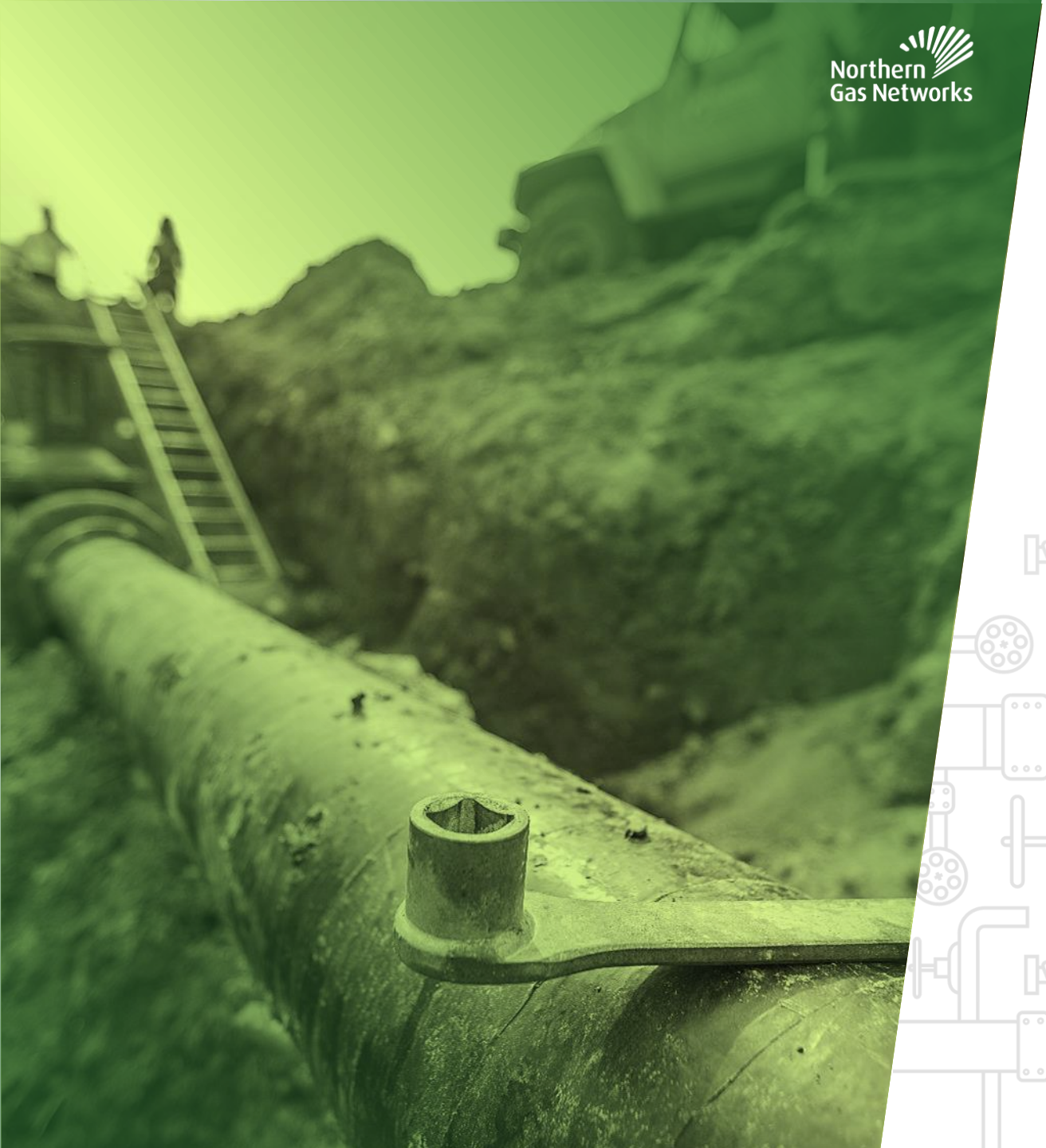


Summary Breakdown of results: Monetised CBA results remain positive across all scenarios considered

Net cost savings[1]

(NPV 2023-2050 in £ 2023, million)

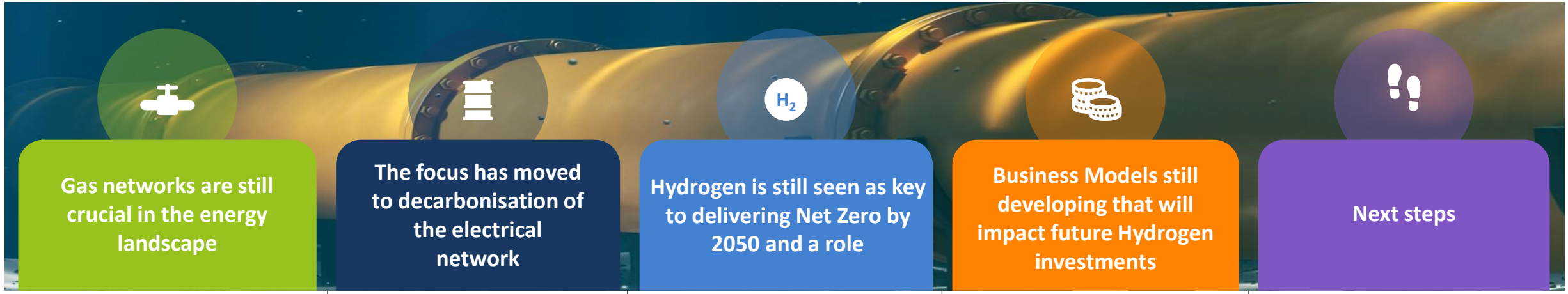
		Case 1 *Base case*	Case 2 *Delayed demand*	Case 3 *Extended pipeline*
Savings related to industrial demand (including energy supply and network cost savings)	Core customers	2,892	2,358	2,892
	Wider roll out customers			894
Savings related to H2P generation (avoided electricity network costs)	Core customers	59	59	59
	Wider roll out customers			6
H2 pipeline CAPEX and OPEX (net of decommissioning costs)	Core customers	- 638	- 638	- 638
	Wider roll out customers			- 160
Environmental costs (fugitive and construction emissions)	Core customers	- 31	- 27	- 31
	Wider roll out customers			- 9
Net benefits		**2,282**	**1,752**	**3,013**



Northern Gas Networks

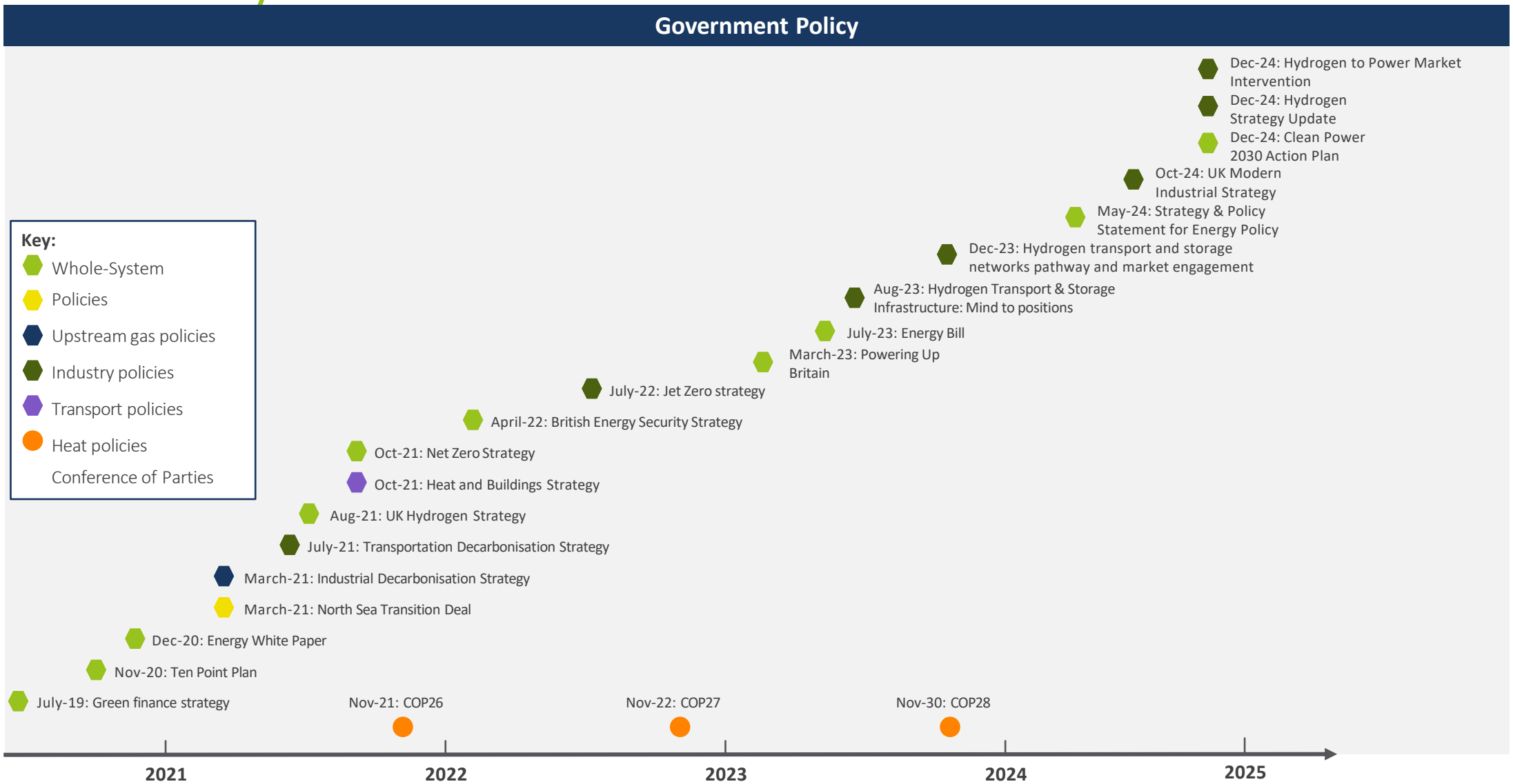
UK hydrogen market overview and how it is evolving as we approach GD3

The future energy environment for ECH



Gas networks are still crucial in the energy landscape	The focus has moved to decarbonisation of the electrical network	Hydrogen is still seen as key to delivering Net Zero by 2050 and a role	Business Models still developing that will impact future Hydrogen investments	Next steps
Methane remains a primary energy source for the UK market across power, heat, industry and transport. It provides a critical low-cost system flexibility, resilience and security of supply. More acknowledgement that methane will be around for longer.	The UK is set to miss legally binding decarbonisation targets. The gap between those targets and the policies to deliver them suggest methane will continue to play a key role up to and beyond 2050.	Low carbon gas will play an important role in a Net Zero Energy system – but where, when and how continues to be debated. Irrespective of those debates, a network will be required to connect supply and demand.	Evolution of the regulatory model is required to support the energy transition (e.g. depreciation, decommissioning).	Policy decisions continue to be pivotal in determining the pace and ambition of investment in abated gas adoption. .

The UK Government continues to develop policy for shaping the technologies that will enable system wide decarbonisation



Source: Analysis based on a variety of publicly available Government sources

The Hydrogen Transport and Storage Business Models are under development in the UK to support hydrogen infrastructure development

Overview of the Hydrogen Transport and Storage (T&S) Business Models

The following minded-to positions on Hydrogen T&S business model design were announced by HMG in August 2023, with both due to be completed in 2025

Transport:

- **Business Model:** Regulated Asset Base (RAB) Model and/or external subsidy mechanism to ensure charges for initial projects are not prohibitive
- **Allocation:** Funding allocation based on 'strategic planning' (initially by HMG, with NESO taking over from 2026)

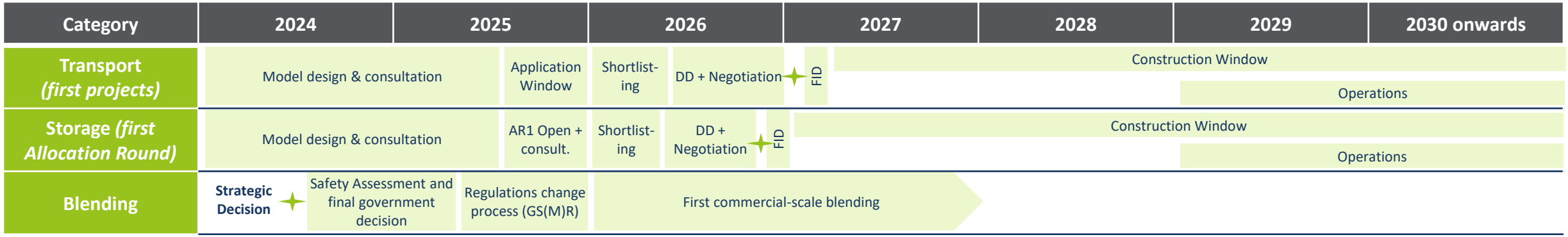
Storage:

- **Business Model:** Revenue floor with additional mechanism to enable both Storage owner and Government to benefit from upside
- **Allocation:** Up to two projects supported in first round, to be on operation or construction by 2030, with further competitive rounds TBA

Blending:

- In December 2023, Government announced it would allow some initial projects blending into the grid as a 'reserve offtaker', subject to the outcome of the assessment of safety evidence by the HSE

Timelines



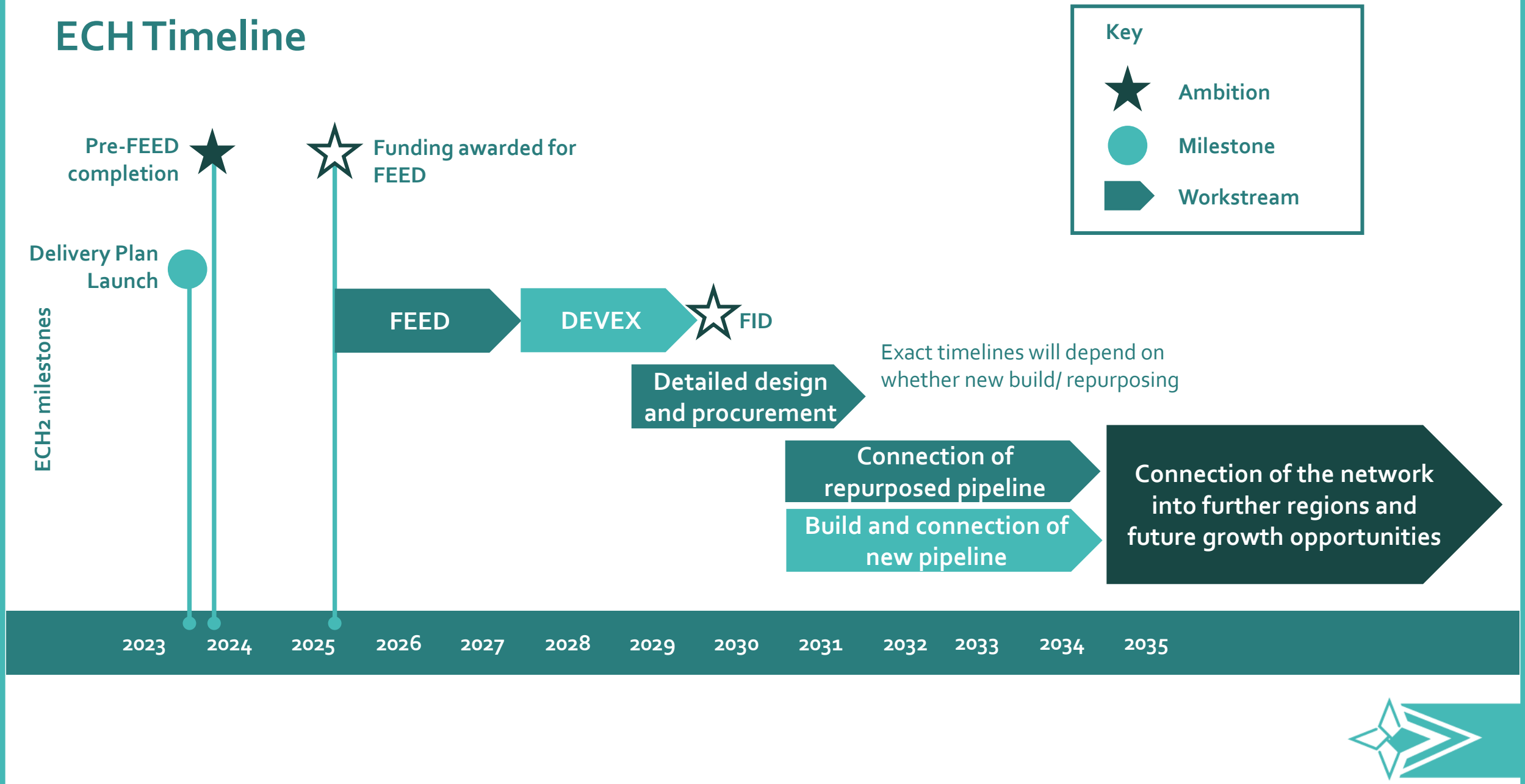
Source: Information and timeline based on a variety of publicly available Government sources



Progress to date

• Feasibility Study	2021
• Pre-FEED Study	2022 – 2023
• Joint Delivery Plan	Nov 2023
• Reopener triggered	Jan 2024
• Re-opener Submission to regulator-Ofgem	Mar 2024
• Ofgem clarifications period	Aug 2024 – Dec 2024
• Positive Minded to decision	Feb 2025
• Ofgem Consultation	Apr 2025
• Preparation for FEED	Ongoing
• Anticipated final Ofgem determination	June 2025

ECH Timeline





Preparing for FEED

Cost
- CAPEX
- OPEX
- Finance Cost

Risk
- Risk Profile
- Risk Management Plan

Permissibility
- Enquiry Land
- Planning and Consent
- Compliance & Safety
- Operability

Collaboration & Relationships
- Contracts
- Relationship formalisation

Project Cost & Solution

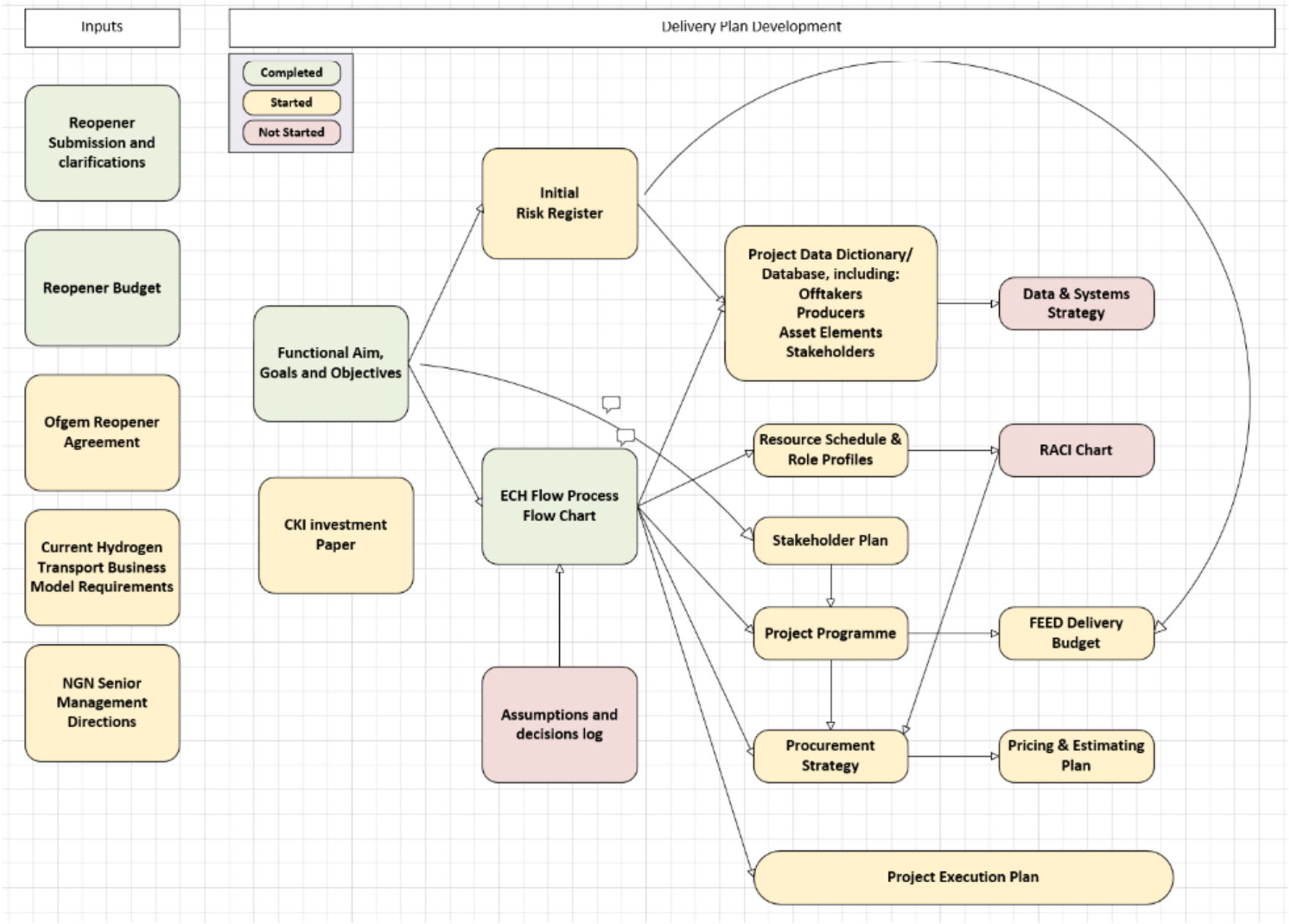
Ofgem NZASP Team

DESNZ (HTBM)

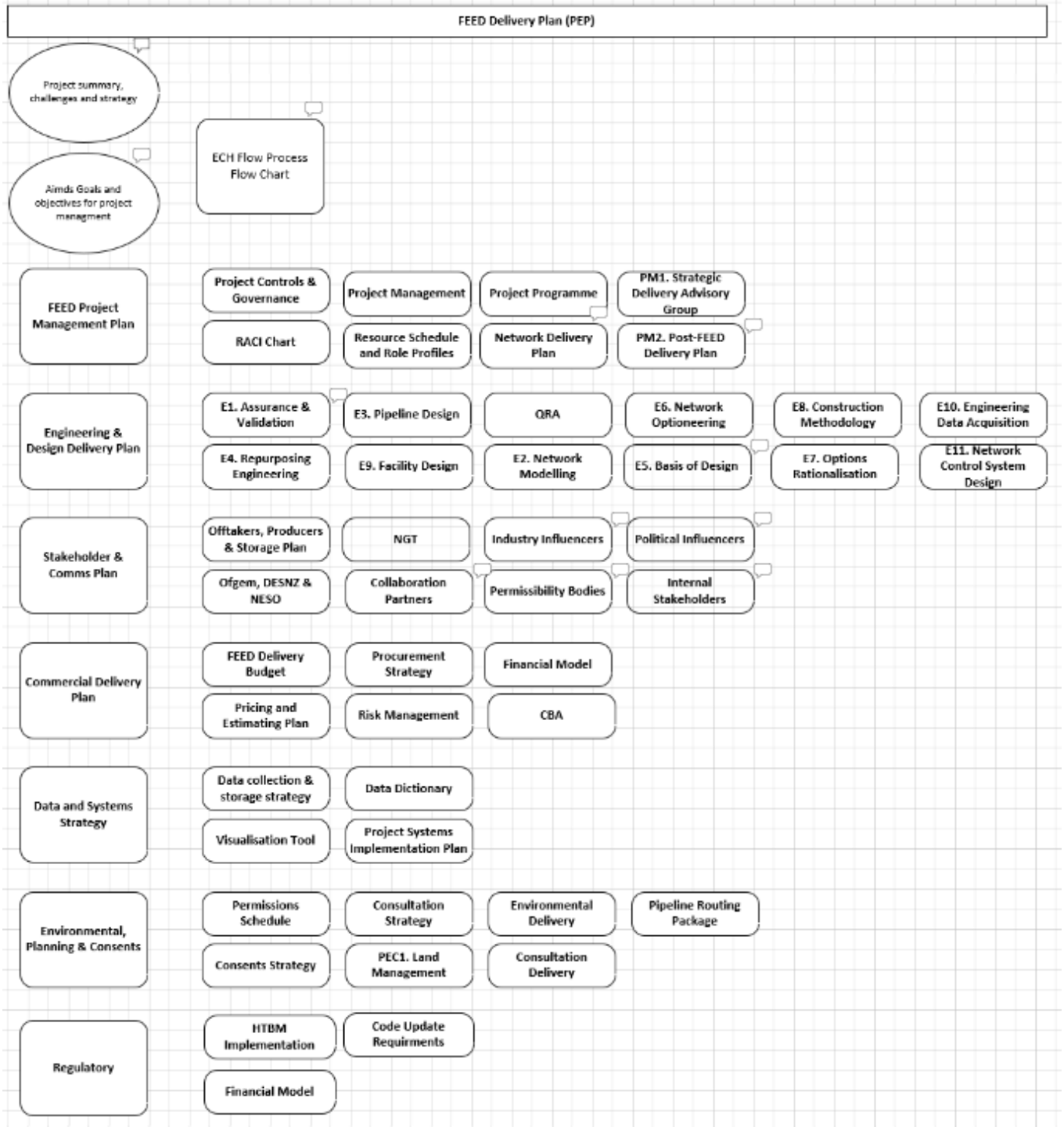
National Gas Transmission

CKI Investment Team

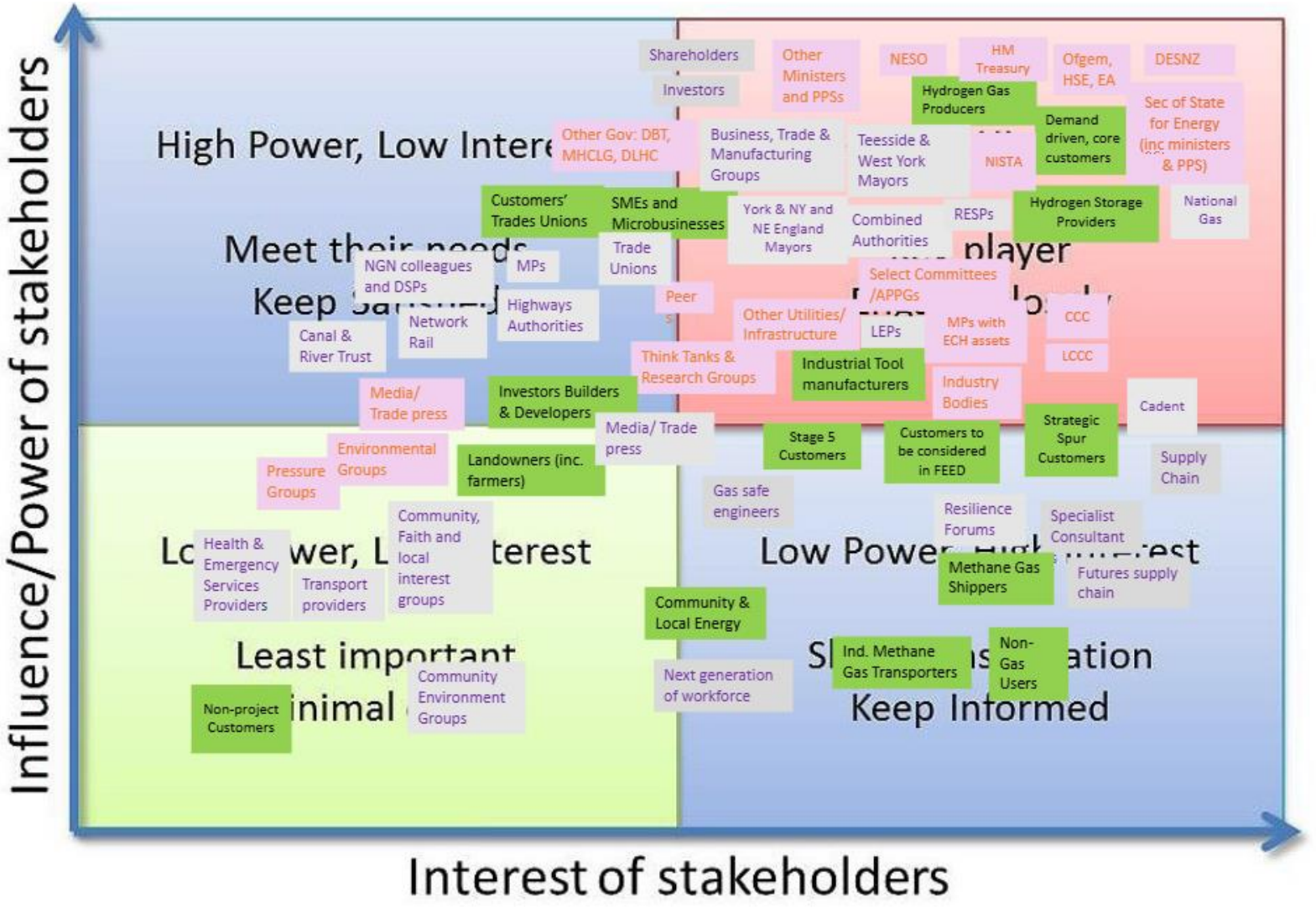
FEED Delivery Plan Development



FEED Delivery Plan Implementation



Stakeholder Map



Next Steps



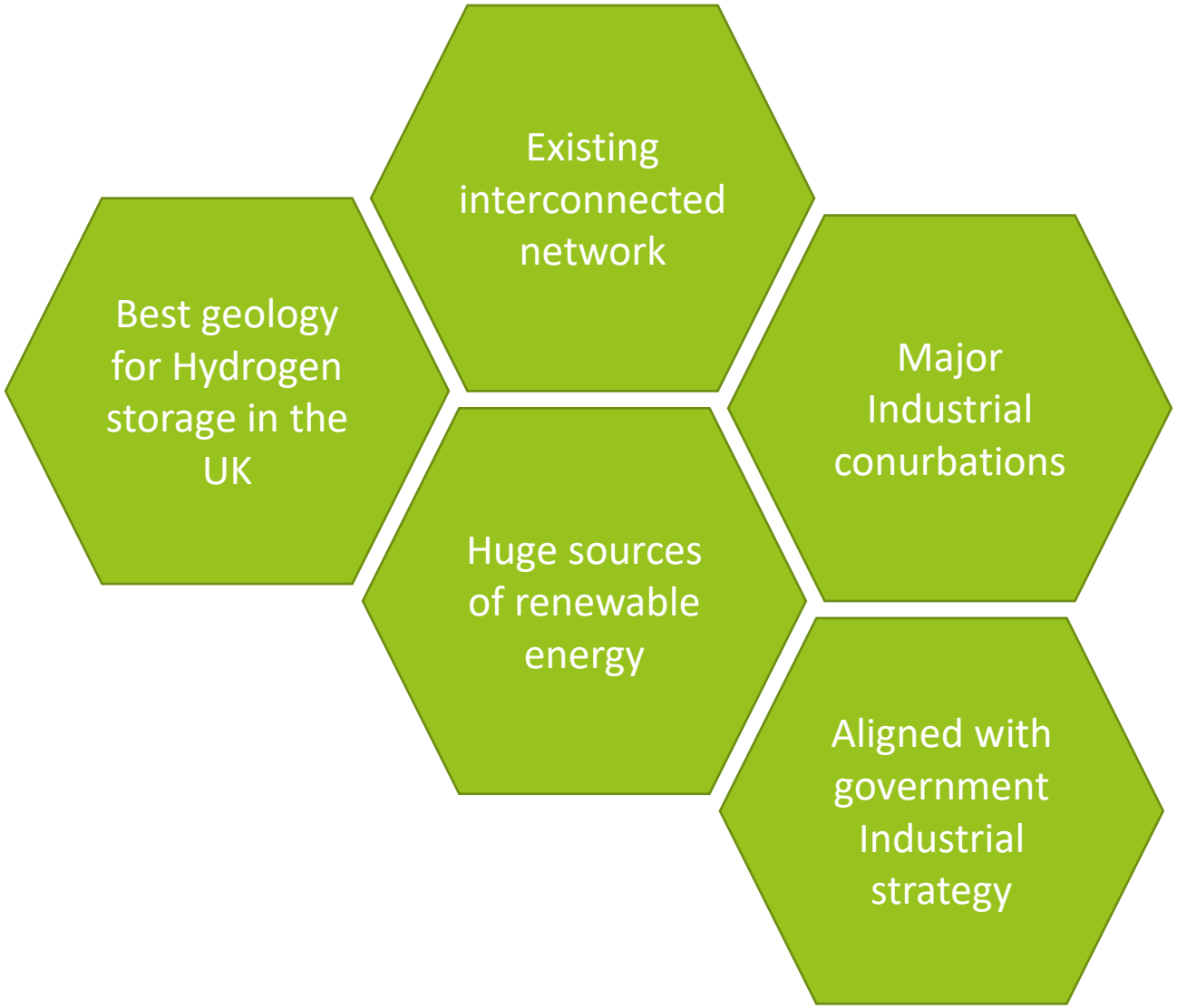
The Future

- Ofgem final determination
- Determine the outstanding project deliverables with DESNZ and future investors
- Complete the FEED delivery plan
- Establish full project team
- Deliver FEED in line with delivery plan
- Ongoing engagement with DESNZ and investment partners on the Transport and Storage Business Model
- Plan for the next stage – DEVEX , DCO Planning approval and FID

ECH Challenges



ECH Opportunities



ECH Challenges - Policy and Regulation and Commercial viability

Key challenges	Complexities	Potential solutions
The HTBM gets further delayed	• Details of the HTBM are required in FEED to firm certain aspects of the project proposition • Delays to these could cause rework further down the line	• Continue with low regrets work as part of FEED • Continue engagement with DESNZ offering advice and support where appropriate.
Meeting DESNZ requirements on affordability	• As part of the application process, we will need to demonstrate the Needs Case for the project and how it demonstrates value for money / affordability	• Develop the design throughout FEED and DEVEX to produce the most accurate overall project cost estimate as possible. • Develop procurement and commercial strategies during the FEED to best value.
Government fails to sufficiently incentivise the hydrogen economy	• For I&C customers to switch to hydrogen, the hydrogen economy will need to be stimulated through business models, but the use of carbon fuels also disincentivised • If the government delays its commitment to its hydrogen strategy, there is a risk that the hydrogen demand will not materialise	• Engage with government to influence the implementation of policies that support the hydrogen economy • Share insights gathered though stakeholder engagement with government to inform their decision making

ECH Challenges - Stakeholder

Key challenges	Complexities	Potential solutions
Delays and changes to NGTs Project Union backbone	• National Gas's project in our region is closely linked to ECH and it will be crucial that both projects are progressed in parallel • There are engineering, planning and stakeholder interrelations and it will be key that these are executed with consideration for the other	• Agree interaction and collaboration between both projects with NGT • Align activities schedules to ensure that inputs and outputs are mapped that allow the project to progress in a timely manner
Public opposition to hydrogen impacting government policy	• Although the project primarily targets I&C customers and public perception of hydrogen use in industry is generally positive, it is important to recognise the opposition to hydrogen in the HRC. Therefore, we should identify this opposition as a challenge.	• Develop stakeholder and communications plan that identifies areas where there could be opposition and put mitigations in place • Map out lessons learnt from Redcar • Non-statutory consultation will take place to ensure any concerns from stakeholders are captured and mitigation plans put in place.
Hydrogen demand does not materialise from I&C customers	• If the government delays providing clear signals on hydrogen and the cost of carbon, there is a risk that we will not be able to generate the certainty required to show I&C users that hydrogen is an option for decarbonising their industrial processes.	• Develop a stakeholder engagement strategy to understand the company's net-zero plans, timescales, hydrogen suitability and future demand requirements. • Offer guidance and signpost to funding support where possible.

ECH Challenges - Technical

Key challenges	Complexities	Potential solutions
Selected assets cannot be repurposed	• Details of the HTBM are required in FEED to firm certain aspects of the project proposition • Delays to these could cause rework further down the line	• During FEED undertake asset suitability for hydrogen assessments. • Undertake innovation projects to fill gaps in material suitability and implement in the design at the earliest possibility. • Improved overall project cost estimate once asset suitability known.
Re-design is required due to new unexpected requirements within IGEM standards	• Some of the design work will take place before all IGEM standards have been updated to include considerations for hydrogen.	• Design of the project will be based on internationally recognised hydrogen standards. • Keep engaged with IGEM governing body and up to date with new changes in standards. • Carryout FEED in such a way that changes in standards will have minimal impact on design delays.
Supply chain readiness	• As a nascent industry in the UK, the supply chain may not be geared up to meet the demands of building ECH	• Work closely with manufacturers during feed to develop hydrogen specifications and ascertain capability of the supply chain. • Work with NGN's operational department to develop the operational and maintenance specifications. • Collaborate with other gas networks to develop these specifications.

ECH Challenges - Internal

Key challenges	Complexities	Potential solutions
Resources	• The project will require significant resource that is different to NGN business as usual capabilities	• Redeployment and development of existing NGNs resources combined with expert supply chain support
Business Support	• To be successful the project we require committed support form all levels of the business	• Engagement with senior leadership in all functions to align requirements with BAU and creation of a senior leadership steering group.
Data & Systems Requirements	• The project is very reliant on the collation and processing of large amounts of NGN and external data.	• Dedicated data and systems manager resource from 3iG • Detailed data and systems plan for the project



Questions?

we are the network