The Context: Current UK Energy Requirements

The challenge is to decarbonise all of the above!
H21 Leeds City Gate – The Blueprint

- 265,000 meter points
- 6Twh per annum, 3180MW peak
- 1% of UK population
- 1.5Mtpa CO₂ storage

DEMAND

UK City by City Rollout

2048 - 2052
The UK Government is Setting Strategic Direction

Hydrogen pathway: ‘…we use hydrogen to heat our homes and buildings, as well as to fuel many of the vehicles we drive in 2050 and power the UK’s industry. We adapt existing gas infrastructure to deliver hydrogen for heating and a national network of hydrogen fuelling stations supports the use of hydrogen vehicles. A large new industry supports hydrogen production using natural gas and capturing the emissions with CCUS.’ (clean Growth Plan)

“We will also continue to explore the long-term options for clean heating and the many potential uses of low carbon hydrogen” (page 45, Industrial Strategy)
# Timeline to a Potential UK Policy & Conversion

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<tr>
<th>CRITICAL SAFETY EVIDENCE</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
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<td>BEIS led: £25m ‘Hy4Heat’</td>
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<td>GDN led: £10.3m H21 NIC</td>
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<td>GDN led: £5m Field trial</td>
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<td>LIVE TRIAL</td>
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<td>Live Trial (one winter)</td>
<td>(NOT YET FUNDED)</td>
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<td>H21 NoE</td>
<td>H21 NoE: £250m FEED Study</td>
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<td>H21 Strategic modelling</td>
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<td>H21 Domestic and commerical metering</td>
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Earliest policy decision
Critical Evidence: Hy4Heat/H21 NIC

Government Programme - £25m (Hy4Heat) Downstream of the meter

- Safety evidence
- Capital Stimulus to the Appliance Market

H21 NIC £10.3m Plus Field Trials
A Strategic Alliance utilising respective areas of expertise:

**NGN**
- Hydrogen conversion
- Heat demand profiles
- Onshore gas Transmission

**Equinor**
- Carbon Capture and Storage
- Hydrogen production
H21 NoE Scope of Works

- 1 X H21 LCG (1.5Mtpa)
- 10(MIN) x H21 LCG (15Mtpa)
- 50 x H21 LCG (75Mtpa)
H21 North of England Hydrogen Supply Concept

based on proven and referenced technology

Key Features

- Conversion between 2028 and 2034, 14% of UK heat, 17% UK domestic meter points covered by one project. (Leeds, Bradford, Wakefield, Huddersfield, Manchester, Liverpool, Hull, York, Middlesbrough, Newcastle).

- Design capacity 12.15GW, 85 TWh for heat, Decarbonising heat using existing gas distribution network infrastructure.

- 8 TWh of inter-seasonal hydrogen storage (equivalent to 62,000 mega batteries)

- 125 GW Hydrogen Transmission System

- **20Mtpa CO₂ storage capability by 2034**

- Equivalent security of supply during peak winter (the beast from the east).
H21 XL – A Wider Energy Strategy

Key Features

• A Hydrogen Transmission system routed past Power stations and ‘High Pressure’ industrial Clusters

• Decarbonising Power in addition to heat utilising the same system (101 TWh (H21 XL))

• Decarbonising transport with hydrogen fuelling stations across the North

• The ability to replace all natural gas in the UK by 2050 based on historical hydrogen production additional capacity.
A Six Phase UK Hydrogen Rollout to 2050.

UK Hydrogen conversion position in 2050

Phase 1
H21 NoE
Conversion 2028 - 2034
14% UK heat
30% Power (H21 XL) for North of England

Phase 2
H21 South Yorkshire & East/West Midlands
2033 - 2038

Phase 3
H21 Scotland
2030 - 2032

Phase 4
H21 South Wales & South West
2036 - 2037

Phase 5
H21 East Anglia & Home Counties
2040 - 2045

Phase 6
H21 London
2045 - 2050

50-75Mtpa CO₂
Meeting the Paris Agreement - 2100

A new global hydrogen economy

Transitional to a global hydrogen economy balancing global renewables meeting 2100 Paris targets.
What is the real scale of the energy problem.

H21 North of England requires 85TWh annual energy in a cold year:
- 85TWh = 85,000,000,000,000 Watt hours (85 million million watt hours), this requires:
  - 9.7GW average annual production = 9,700,000,000 Watts

H21 North of England is based on 12.15GW production capacity
- 12.15GW = 12,150,000,000 Watts (12 thousand million watts), based on proven technology utilising an established supply chain
  - 12.15GW is 1215 times larger than 10MW (10,000,000 watts, (10 million watts)),
  - 12.15GW is 81 times bigger than 150MW (150,000,000 watts, (150 million watts))

H21 North of England requires circa 8TWh of inter-seasonal storage
This is 8,000,000,000,000 Watt hours, this is equivalent to 62,015 Australian ‘mega batteries’

8TWh = 62,015 ‘Mega batteries’