

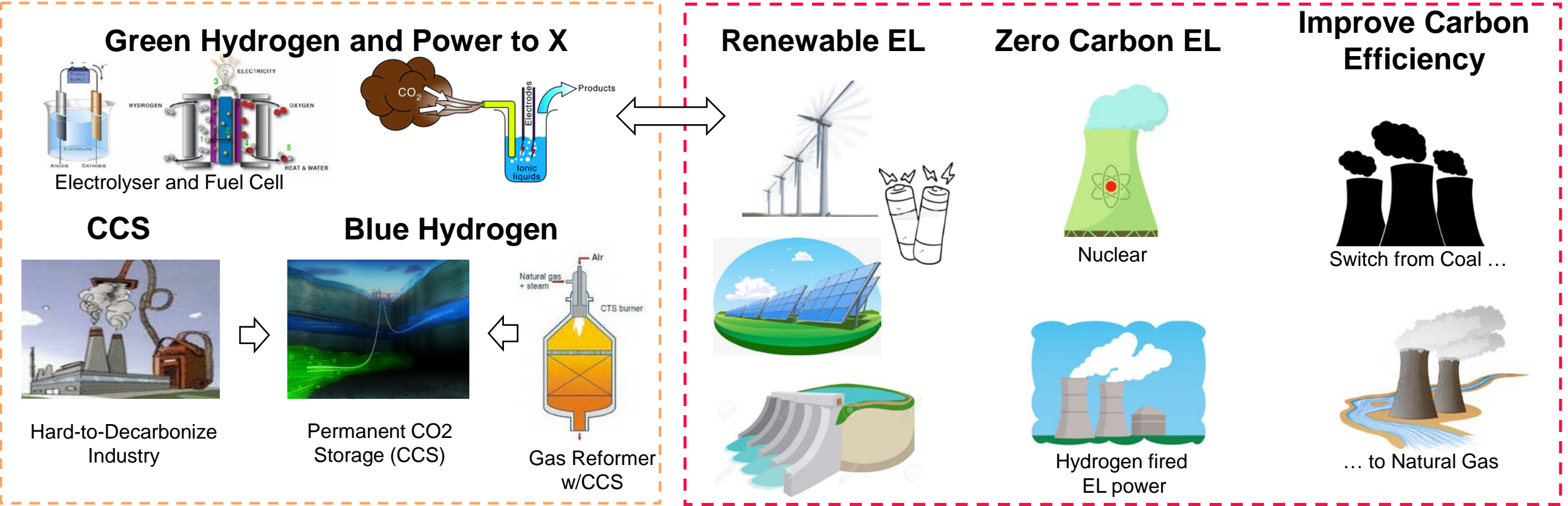
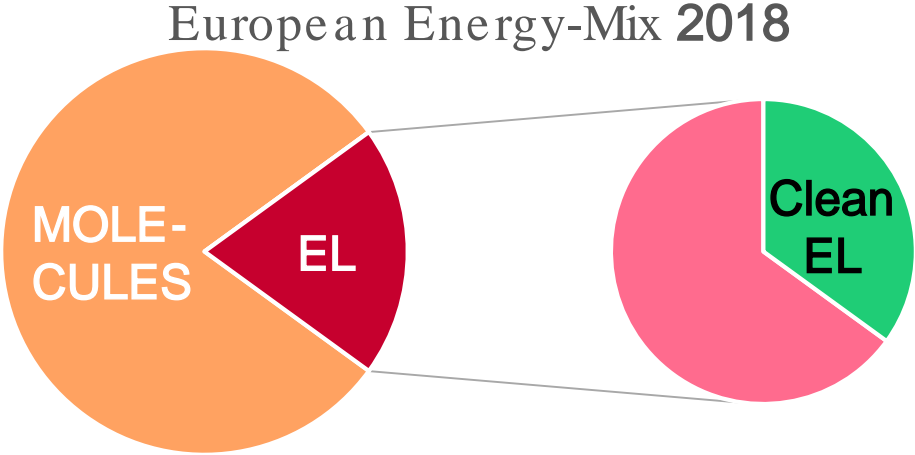
CCS and Hydrogen Projects

Northern Lights - Decarbonising Industry
H21 North of England – Decarbonising Heat
H2M-Magnum – Decarbonising Electricity
Zero Carbon Humber – Decarbonising Industry

The Challenge and the Tool-Box



Cost Efficiency EL : MOL
Energy Transport 1 : 10
Long Term Storage 1 : 100



Blue Hydrogen – What Will it Cost?

<u>Sector</u>	<u>Price Premium</u>	<u>Compared to ...</u>
Industry	+25%	Grey Hydrogen
Heat	+50%	Natural Gas
Power (on demand)	+100%	Natural Gas

A European “open source” network for CO2 removal

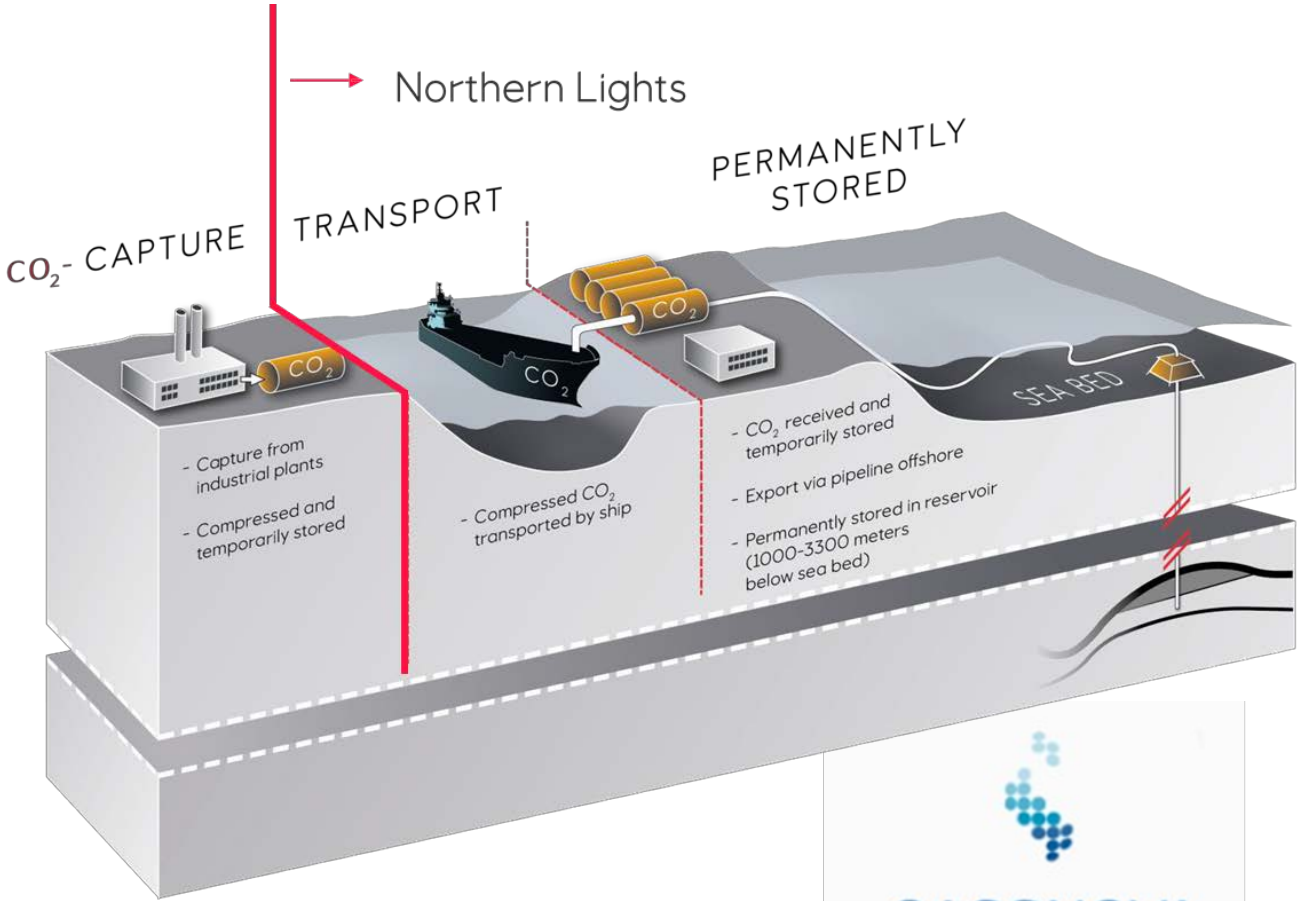


THE EUROPEAN CO₂ NETWORK



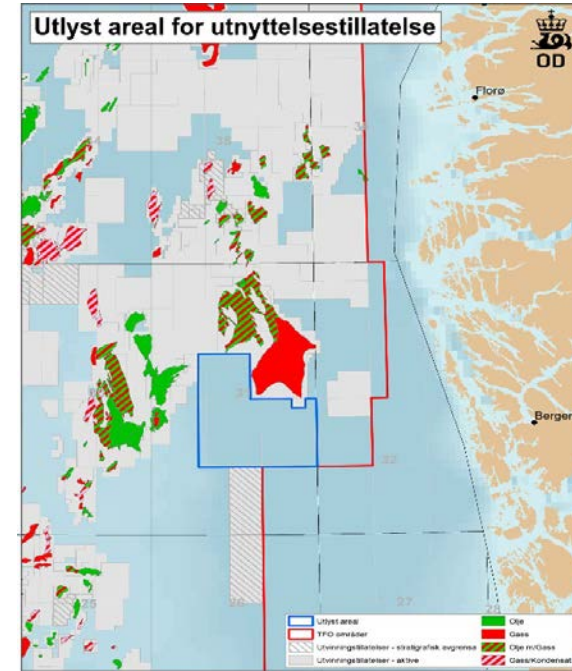
Potential projects
Ongoing projects
Storage sites
CO₂ transport routes

Source: Bellona Europe

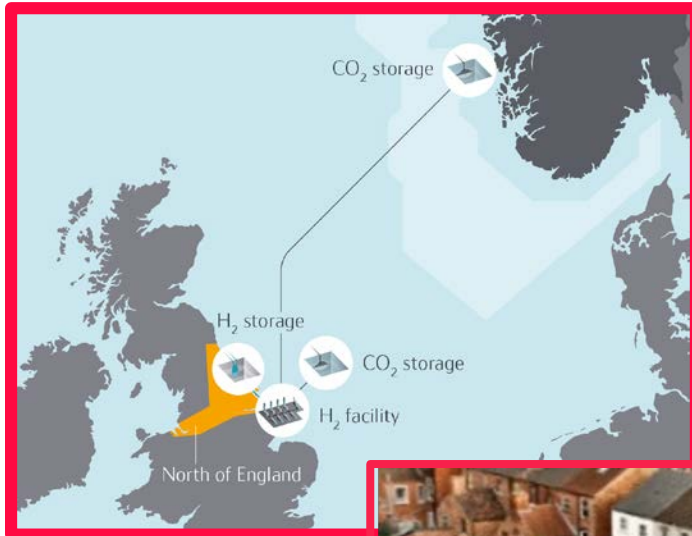


Project status & future

- **Transport, intermediate storage, pipeline**
FEED to be delivered Q3 2019
- **Storage**
 - Use permission Nr 001 given for “Aurora” south of Troll
 - Confirmation well to be drilled November 2019, subsea equipment is being built
- **Potential beyond anchor customers**
In dialogue with 15 possible users in 8 European countries
- **Investment decisions**
Planned for December 2020 (State budget)
- **Operational 2023**
Then all emitters have a storage solution – start capture!



H21 North of England



System approach to decarbonise residential heating and distributed gas

Energy: ~85 TWh (12.5% of UK population)

/ 12 GW hydrogen production

CO₂ emissions reduction: 12,5 Mt CO₂ pa

CO₂ **storage** offshore UK / Norway

8 TWh (**seasonal**) **hydrogen storage**

CO₂ footprint 14,5 g/KWh

Unlimited system coupling

CAPEX: £23 billion



H21 NoE supply concept



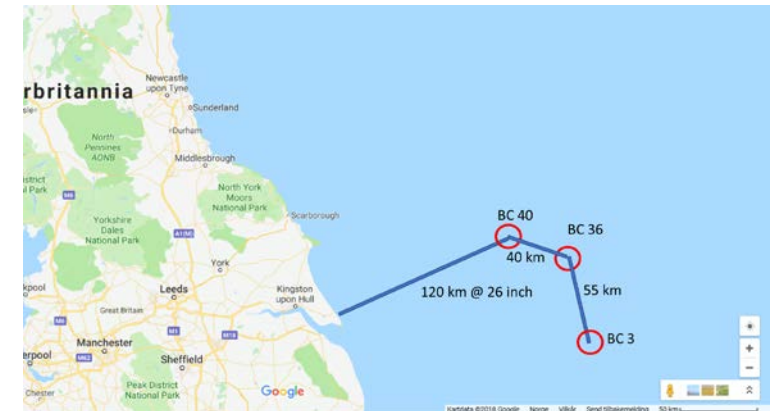
Greenfield Hydrogen Facility

- Location: Easington
- Capacity: 12 GW
- Configuration: Multi train, self-sufficient with power



Hydrogen Storage

- Location: Aldbrough
- Capacity: 8 TWh
- Configuration: 56 caverns at 300,000 m3



CO2 Storage

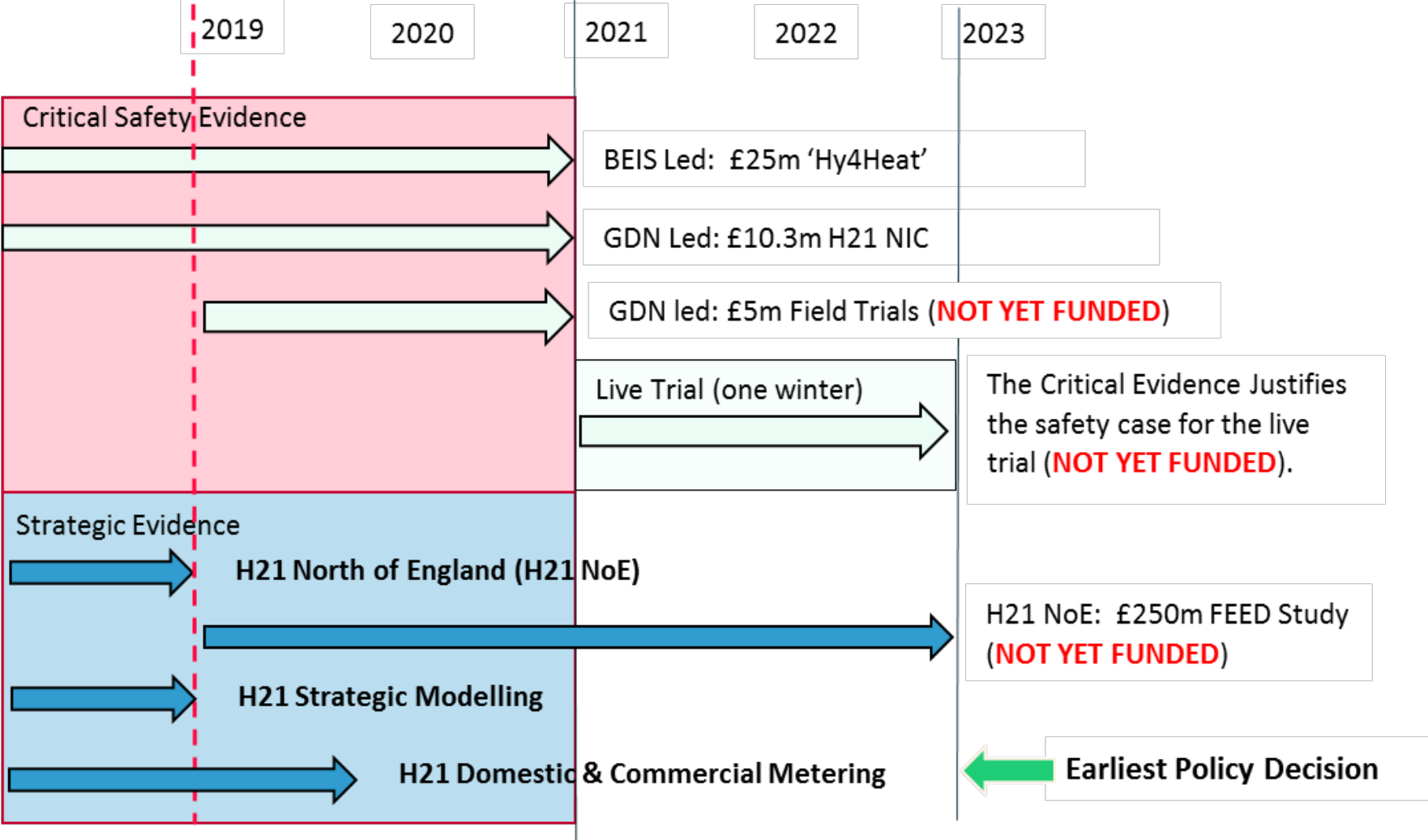
- Location: Bundter
- Capacity: +600 Million @ 17 mtpa
- Configuration: Saline aquifers

H21 - What will it cost?

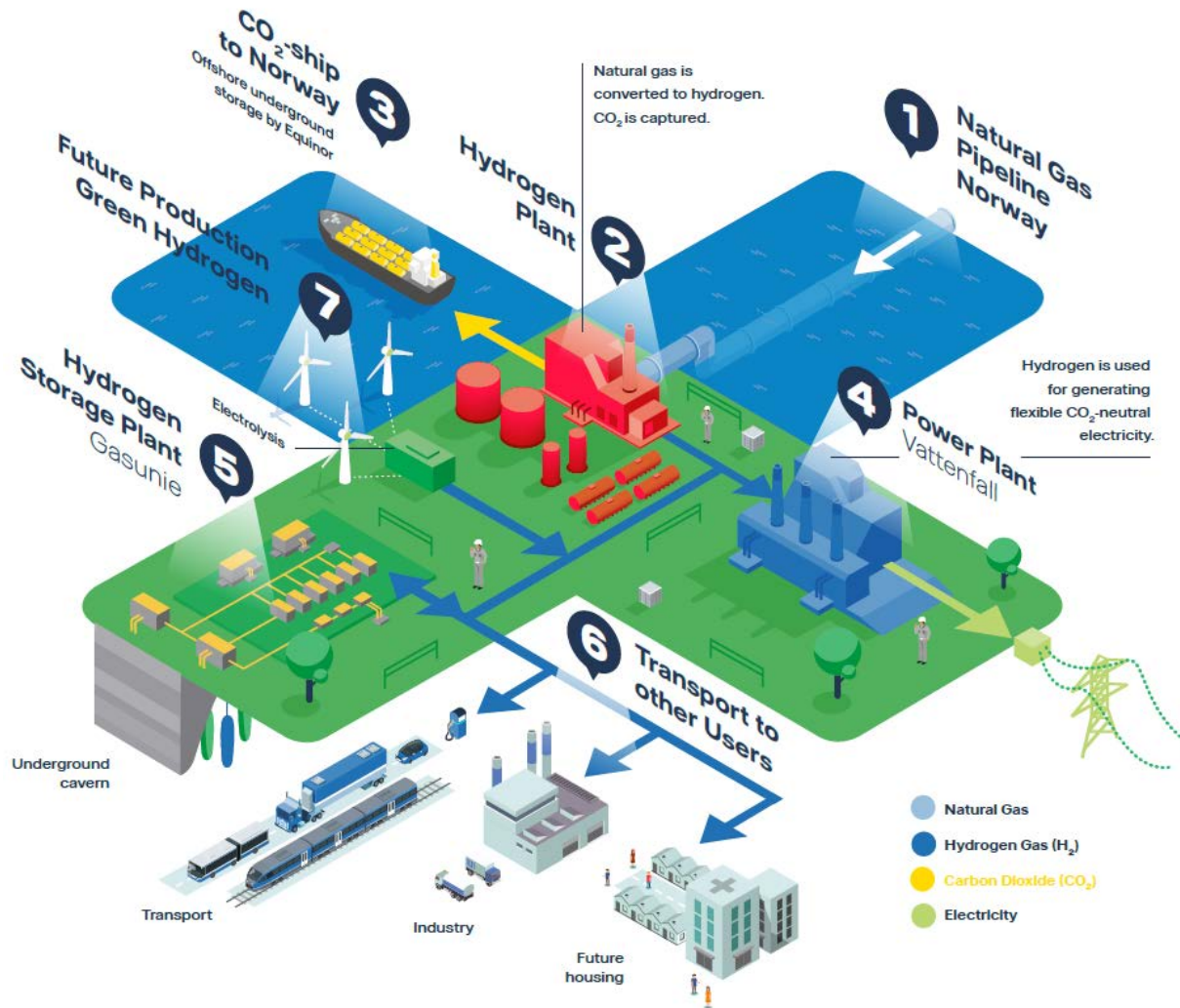
2035 Residential Prices

	<u>2035 Residential Prices</u>	<u>CO2 Footprint</u>
Electricity	£200/MWh (BEIS Projection)	50 g/KWh
Natural Gas	£50/MWh (BEIS Projection)	200 g/KWh
Hydrogen	£75/MWh (H21)	15 g/KWh (H21)

The next steps



H2M – Magnum, Netherlands



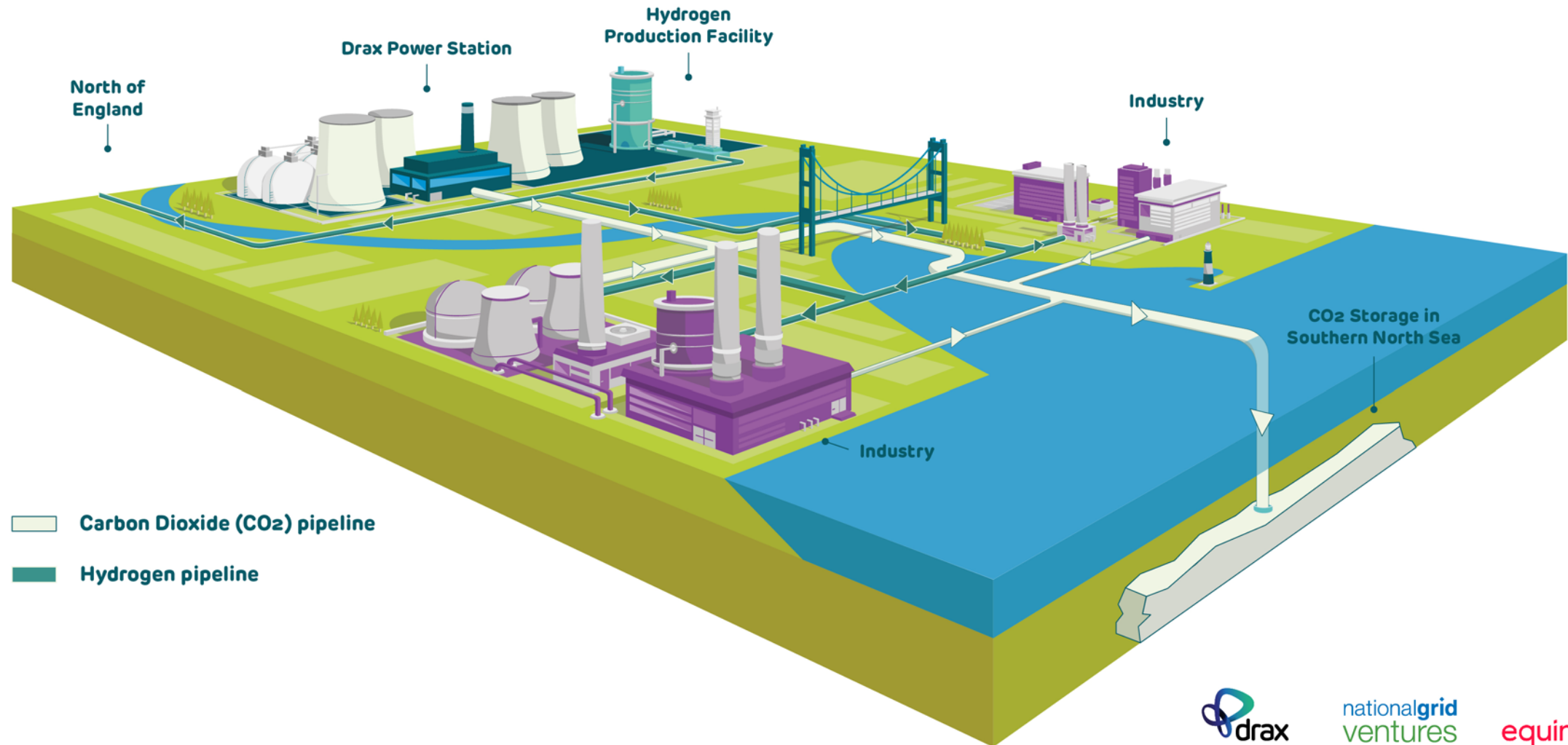
- Energy: 8-12 TWh
- CO₂ emissions reduction of 2 Mton/year
- Utilise existing gas power plants and gas infrastructure
- Switch fuel from natural gas to clean H₂
- Clean, flexible electricity as back-up for solar and wind
- Launch large-scale H₂ economy

• Partners:



Zero Carbon Humber

Our vision



CCS Projects

Northern Lights - Decarbonising industry

H21 North of England – Decarbonising heat

H2M-Magnum – Decarbonising electricity

Zero Carbon Humber - Decarbonising industry

Steinar Eikaas

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