



HyNet North West

I-SEE Bath University

Dr Chris Manson-Whitton

2nd March 2021





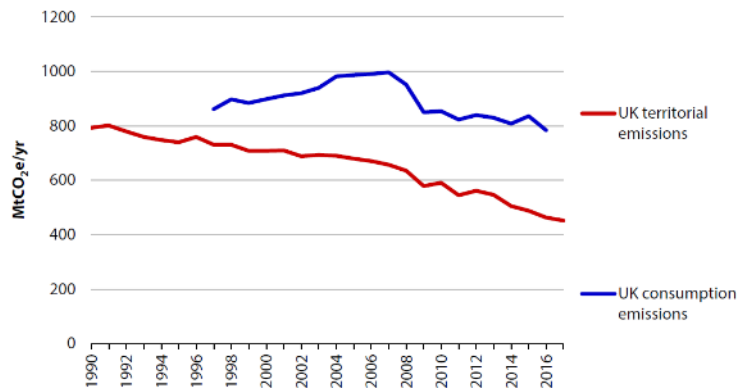
Progressive Energy



- Founded in 1998 to deliver material reductions in carbon emissions
- Making things happen with effective collaboration

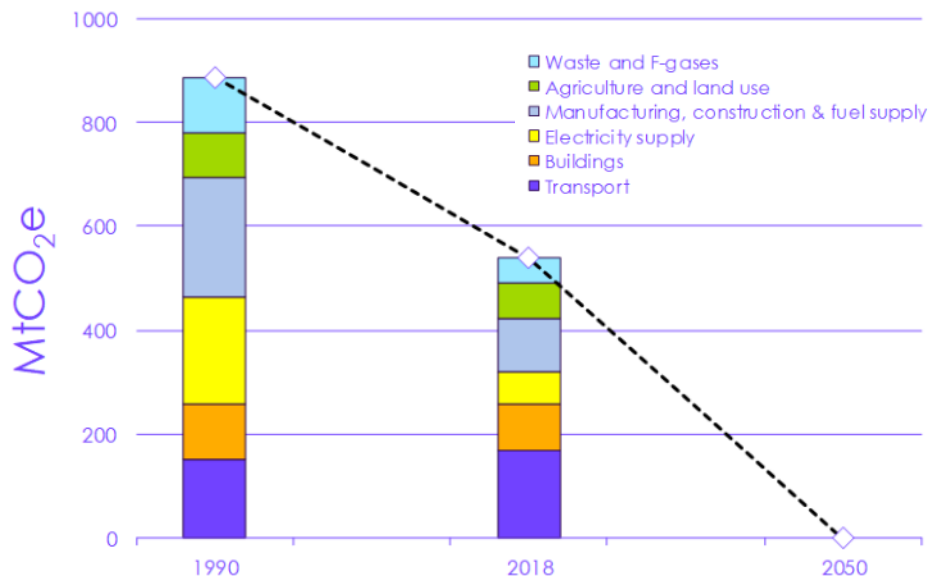
What does Net Zero 2050 mean?

- There is nowhere to hide
- We will need all solutions
- Often it is about the vector as much as the primary source



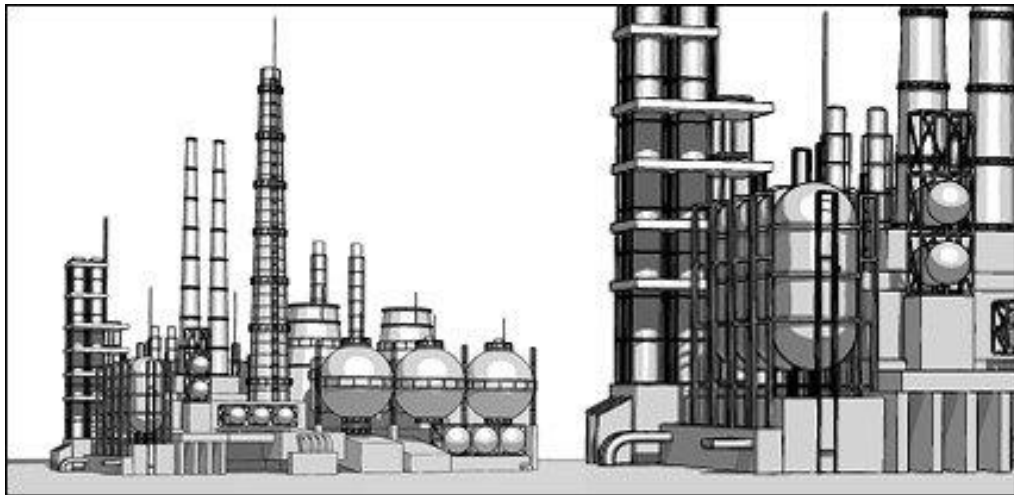
CCC Net zero report 2019 (fig B3.3)

“To meet Net Zero, emissions must fall in all sectors and at a faster rate than the last 30 years”



CCC 6th Carbon Budget 2020 (fig2.2)

Industrial energy demand



■ Why does industry need to tackle its carbon intensity?

- CSR requirements
- Customer demands
- Economic threat

■ Potential Solutions

- Energy efficiency
- Capture carbon when burnt
- Switch to different fuels:
electricity, biomass, hydrogen

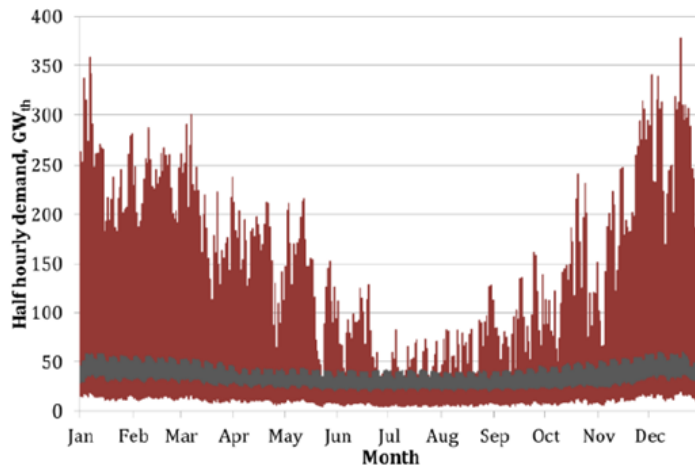
Domestic Heat

■ What are the challenges in decarbonising heat

- UK housing stock characteristics
- 80% of 2050 homes already exist

■ Potential Solutions

- Energy efficiency
- Switch to different fuels: Electricity, biomass, hydrogen



Robert Sansom Imperial College

*23 million UK customers
consuming 320TWh pa
of gas (83% of homes)*



Dispatchable Power



■ Massive growth in renewables

- Brilliant progress
- But how do we balance the system?
- How do we handle increases - impacts of electric vehicles & heat pumps

■ Solutions

- Change and shift our demand patterns
- Store electricity
- Generation we can bring on line rapidly
- Hydrogen & CO₂ capture

Mobility



■ Electric Vehicles gaining traction rapidly

- Strong policy signals
- In 20 years we won't believe what we did today
- What about larger vehicles, especially range, charge time etc?

■ Solutions

- Truly fungible Bioliquids
- BioCNG
- Hydrogen

What have fossil fuels done for us?



- **The trouble is they are brilliant!**
 - Plentiful supply
 - Very energy dense and easy to transport
 - Easy to store
 - Pretty much always there when we need them
 - Cheap
 - We have built the fabric of our society out of them
- **It is going to be a journey to ween ourselves off them – but we absolutely have to.**



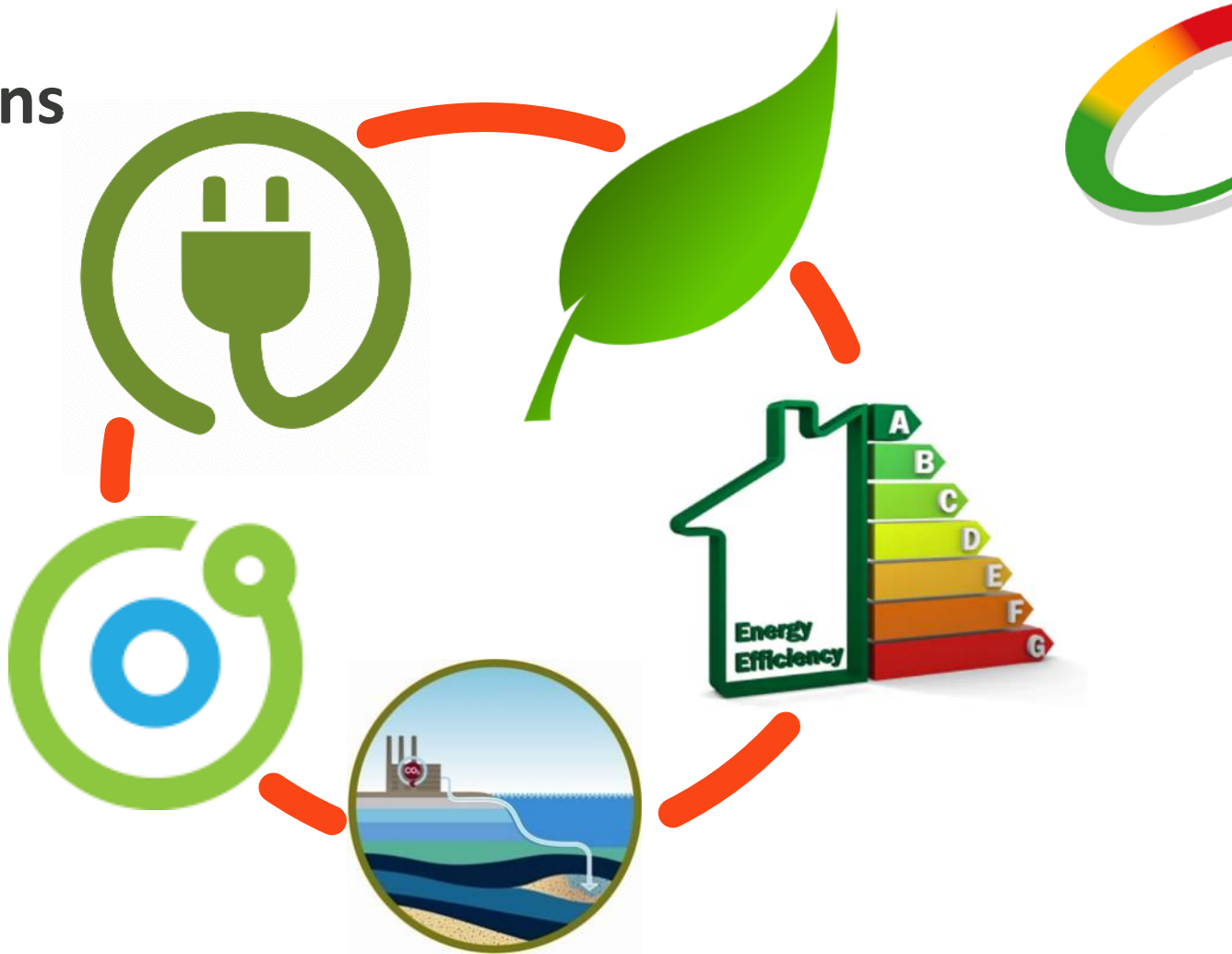
Behavioural implications

- We have got used to cheap & ready energy



Suite of solutions

*We need all
the tools in
the book*



Delivering low carbon hydrogen



***‘Significant volumes of low-carbon hydrogen must be produced at multiple industrial clusters.’
Hundreds of TWh of hydrogen***

Low carbon hydrogen offers cost effective decarbonisation for a range of sectors



Key to decarbonise ‘hard to reach’ sectors



Energy Intensive Industries



Domestic and commercial space heating



HGVs, buses and trains



Flexible generation to ‘balance the grid’ with intermittent renewables

Sources of low carbon hydrogen



Blue hydrogen



Electrolysis



Biohydrogen

Key factors: Scale, cost, maturity, resource, carbon intensity

Hydrogen build out by sector



✓ Industry



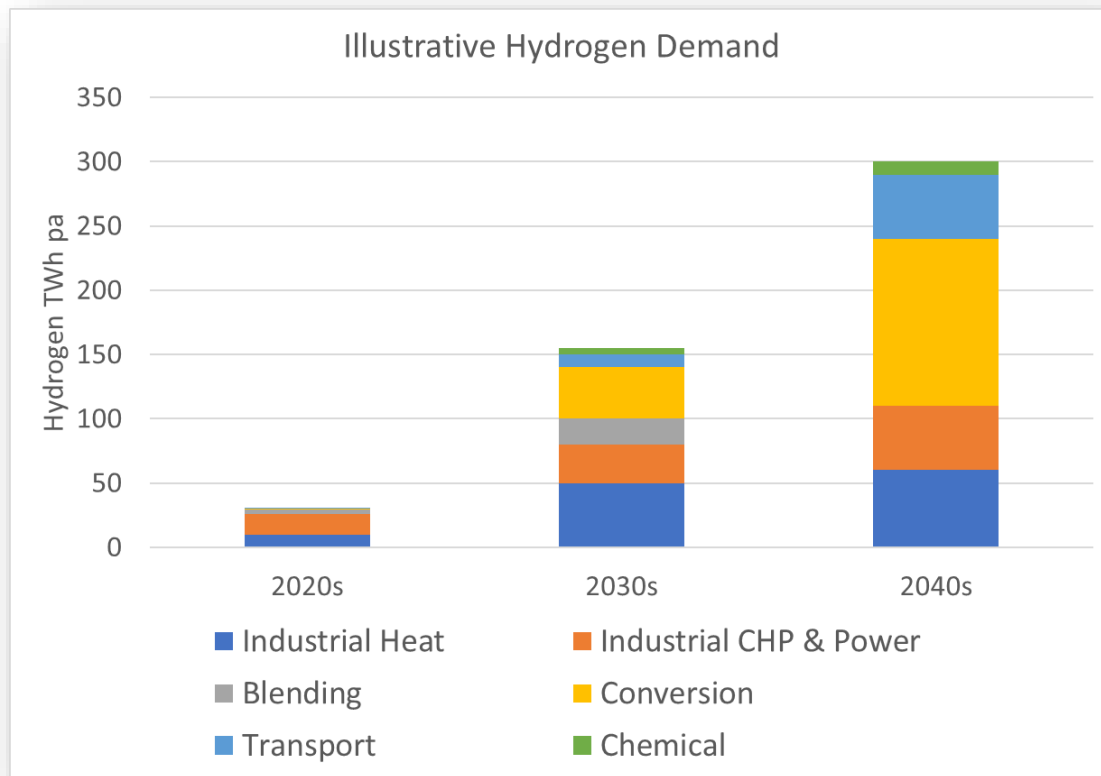
✓ CHP & Power Generation



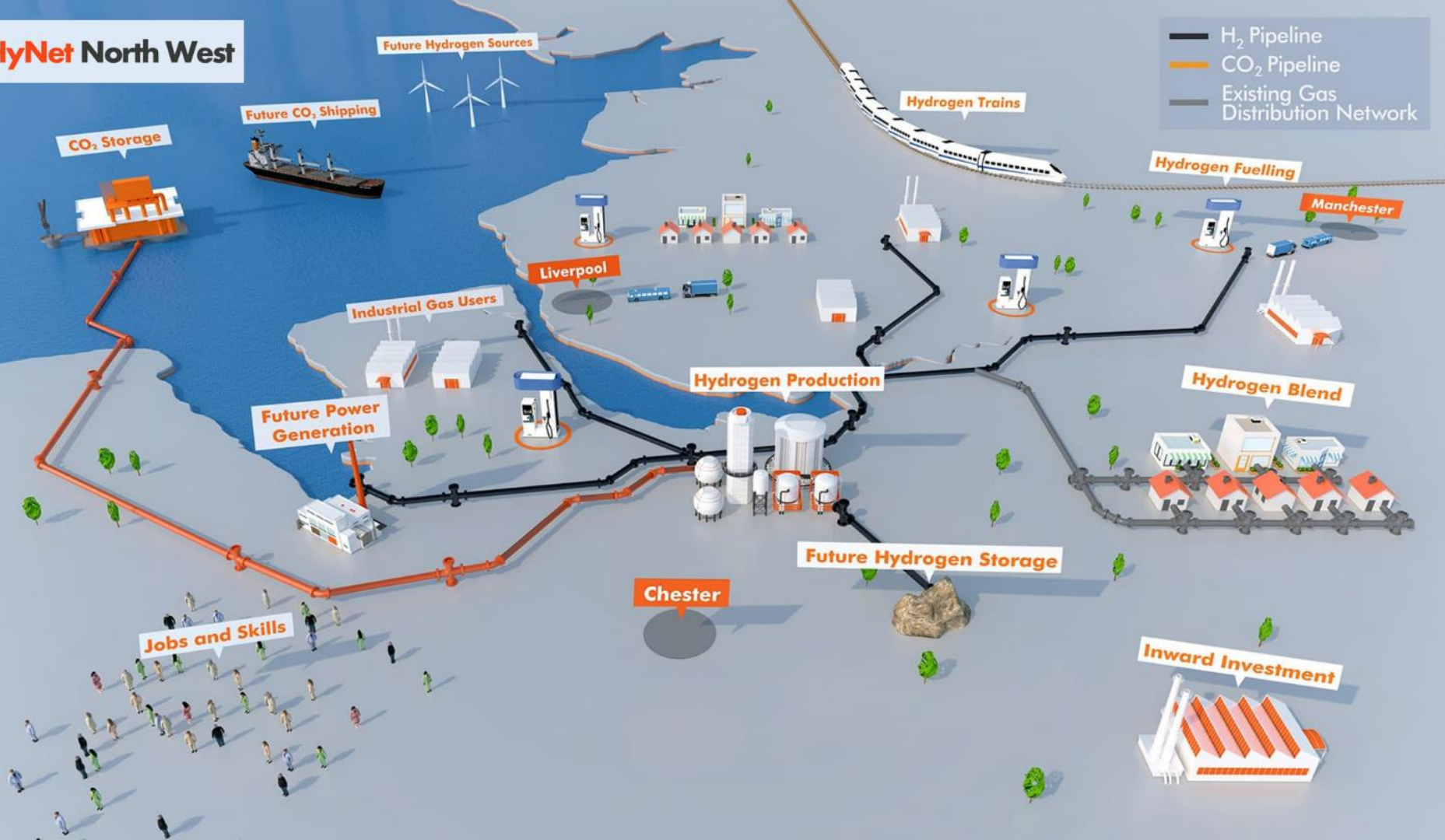
✓ Blending & Grid use



✓ Mobility



HyNet North West



HyNet: Delivering the UK's leading H₂ & CCUS Project



HyNet delivers against the 10 point plan

- 80% of Hydrogen Production Target (3.85GW vs 5GW by 2030)
- Up to 100% of CCUS Target (10MTPA capacity by 2030)
- Hydrogen Village & Hydrogen Town

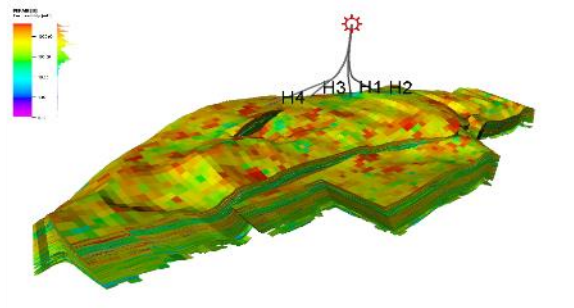
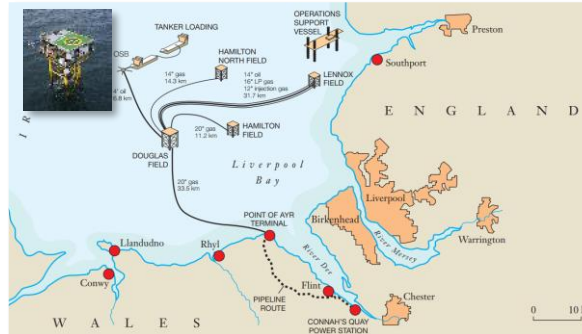
Partnership for delivery



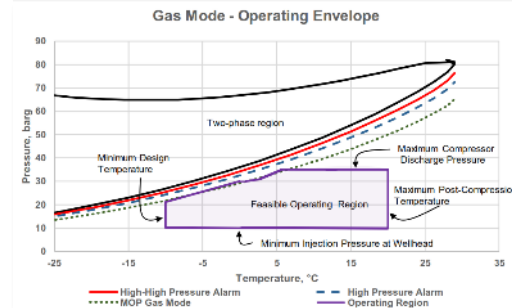
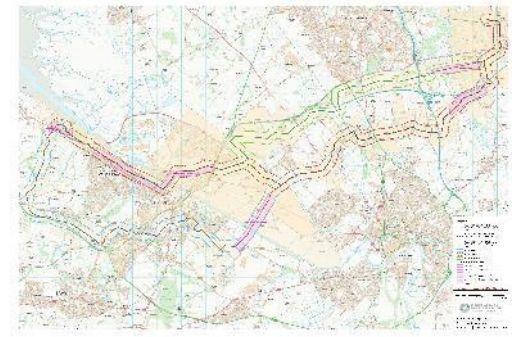
HyNet: Delivering CCUS infrastructure



Storage



Transport



HyNet Delivery: Industrial Capture

CF Fertiliser Plant



- 400,000 tpa of pre-captured CO2
- Provides certain & low cost CO2 to de-risk FID, commissioning and operations



Hanson



- Opportunity to tackle carbon emissions from cement industry



Essar



- Tackling chemical carbon emissions from the refinery sector

HyNet Delivery: Hydrogen Production



Technology

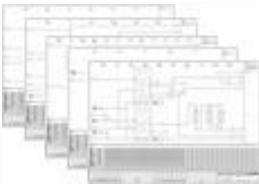


JM Johnson Matthey
Inspiring science, enhancing life

High Capture Rate
Low cost

- Johnson Matthey LCH technology
- Based on 1980's ICI technology for Ammonia production
- Inherently lower cost than SMR for capture as single high pressure CO₂ stream
- 3TWh pa, 83% efficiency, 97% capture
- £280m per line

Development



Pre-FEED
Engineering
complete



FEED
Engineering
underway

Hydrogen project aims to drive UK transition to a low-carbon economy

Essar plans to supply industry and homes in north-west England after £750m investment in two plants

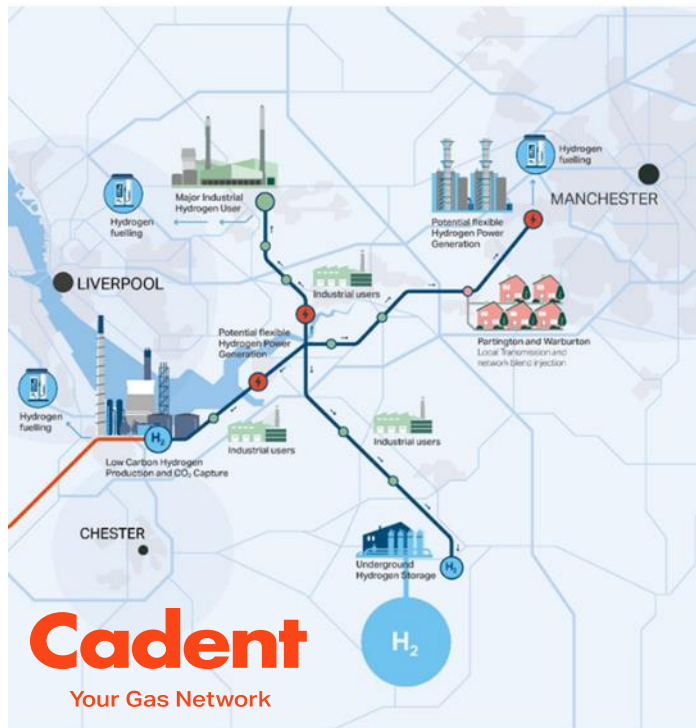


FT
FINANCIAL
TIMES



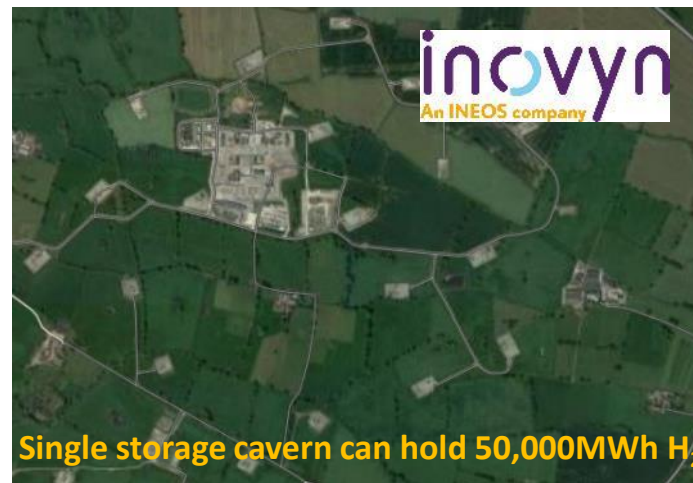
ESSAR
Joint Venture

HyNet: Hydrogen Distribution & Storage



The only UK cluster linking hydrogen production to distribution infrastructure, Supplying to industrial customers - and into the existing gas grid

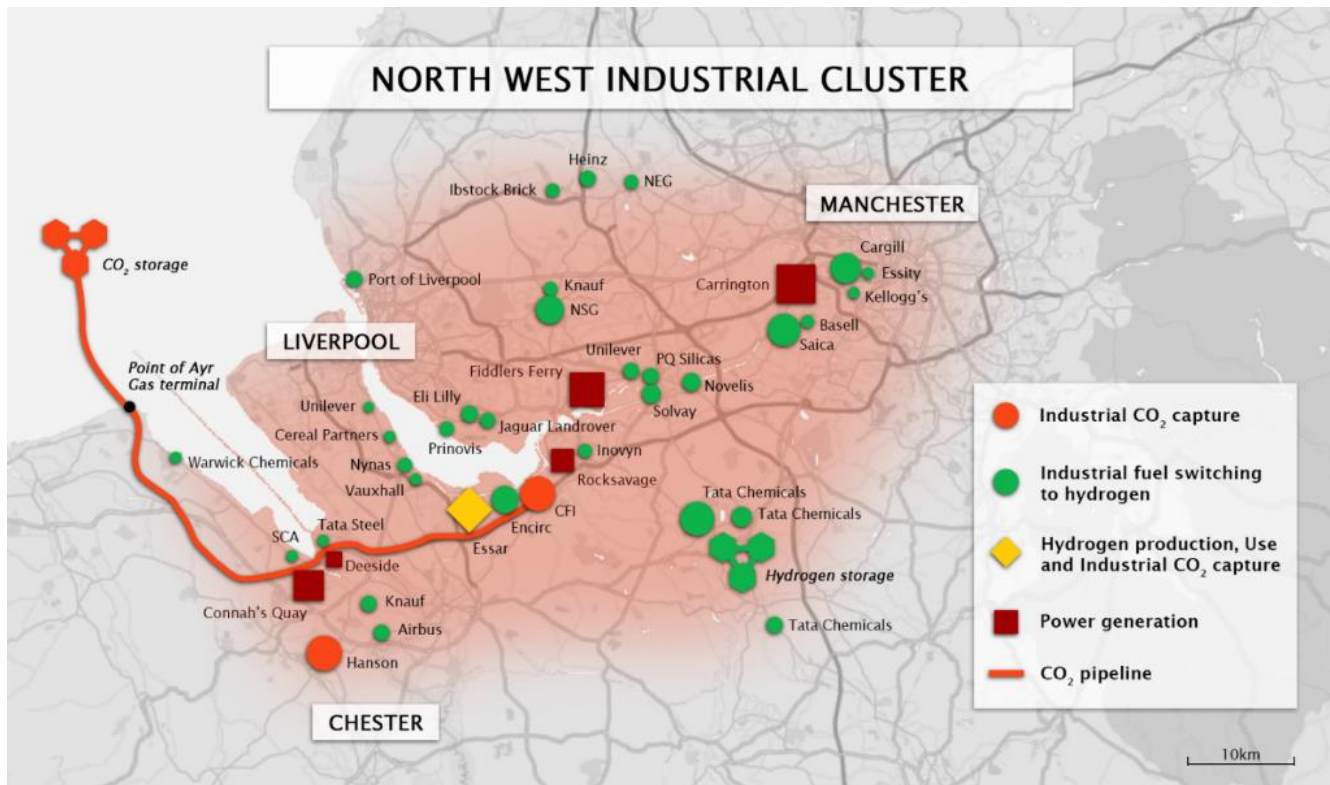
THE BIGGEST SALT CAVERN STORAGE FACILITY IN THE UK



3 orders of magnitude bigger than the world's largest battery system

Hydrogen Industrial Fuel Switching

Decarbonising, Safeguard, Growing



Blending into the gas grid – a key enabling step



***Non-disruptive
& low cost for
early adoption***



***Meaningful
decarbonisation
in its own right
29TWh pa in UK***



**Equiv. 2.5
million cars**

***Build up material
H₂ production
capacity***



***Establish key
regulatory
positions***



***Developer wider
H₂ industry
supply chain***



***Address customer
perceptions***



***Unlock use of
hydrogen more
widely***



**100%
+**





To establish that a blend of hydrogen and natural gas can be distributed and utilised safely & efficiently in the UK distribution network without disruptive changes for consumers.



Keele University own and operate their own gas network – typical of a small town

Cadent

Northern Gas Networks



Progressive energy

ITM POWER
Energy Storage | Clean Fuel



Keele
UNIVERSITY



RIIO **NIC**
NETWORK INNOVATION
COMPETITION

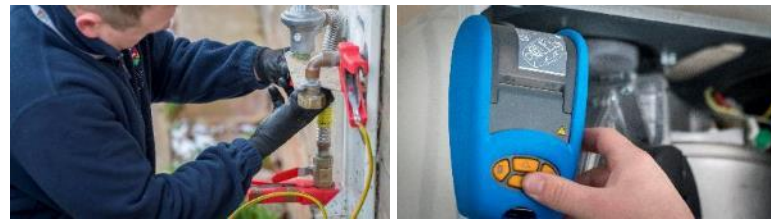
Project Funded under OFGEM's
Network Innovation Programme



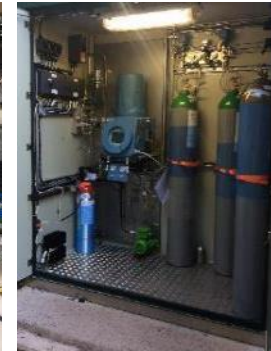
- The UK has an excellent safety and regulatory regime. Evidence required to demonstrate 20%vol hydrogen is as safe as natural gas



Based on 18 months of extensive rigorous research HyDeploy secured the UK's first permission for blending hydrogen into the grid in November 2018.



HyDeploy Building out the facilities



HyDeploy Successful operations



- ✓ Safe appliance operation
- ✓ No increase in reported leaks or faults
- ✓ Uniform network composition

Contented customers
“Thinking about how little I’ve had to think about it means that’s, that’s part of why it’s such a great project...the work is not put in by the consumer...oh I’m contributing by doing nothing. Where else do you get to do that?”



- Winlaton near Gateshead
- Isolated network for injection
- *668 properties, 1200+ domestic appliances*

https://www.youtube.com/watch?v=B_qHmlVw88Y

- Finalising safety case with HSE

Winlaton To Host Pioneering Hydrogen Energy Pilot HyDeploy

November 11, 2019



GAS customers in Winlaton, Gateshead, will become the first on a public UK gas network to use blended hydrogen for heating and cooking, as the country's gas distributors demonstrate ways to cut climate-changing carbon dioxide (CO2) emissions.



A journey to 100% Grid Conversion

1. Hydrogen ready boilers have been developed
2. H21 programme is undertaking upstream activities
3. Hy4Heat has undertaken downstream assessments
4. 10 point plan calls for a hydrogen neighbourhood by 2023, a hydrogen village by 2025 and a town by 2030



HyNet Homes

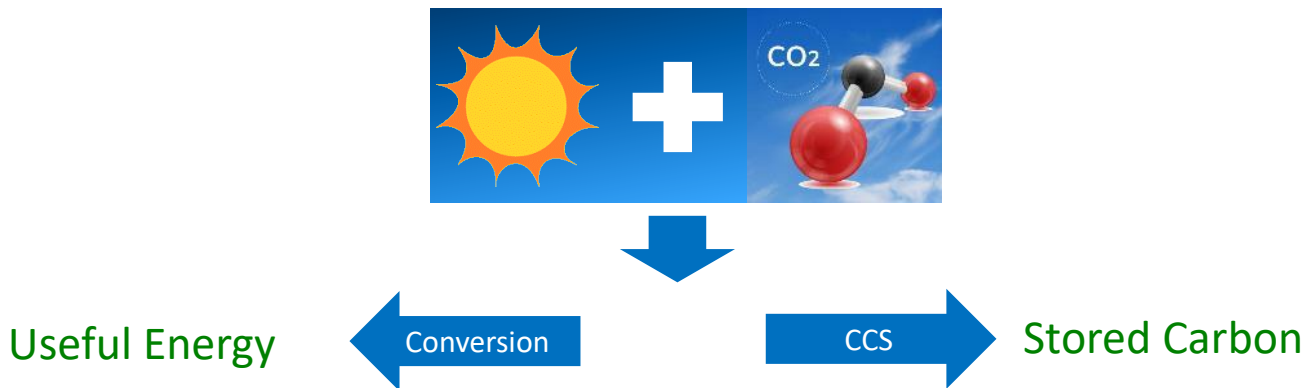


'Greenhouse Gas Removals' technologies



Air is (just!) 400ppmv CO₂ and at atmospheric pressure

Biomass is a highly refined 'self replicating' mechanism for capturing carbon from air



Project BRIGHT

Plans for £150m UK bio-resources-to-fuel facility approved

Plans to build the UK's first commercial-scale Bio-Substitute Natural Gas (BioSNG) plant have been approved by the council.

Cheshire West & Chester Council's planning committee gave the green light to the £150 million (€174.2 million) project at Peel Environmental's Protos site in Ellesmere Port, which will generate renewable gas from up to 175,000 tonnes of bio-resources, such as unrecyclable wood and refuse-derived fuel (RDF).



1. Will Convert Household waste and unrecyclable wood into transport fuel for 1000 HGVs or buses
2. Slip stream of Biohydrogen
3. Will use the HyNet CCS infrastructure deliver 100,000 tpa of 'negative' emissions

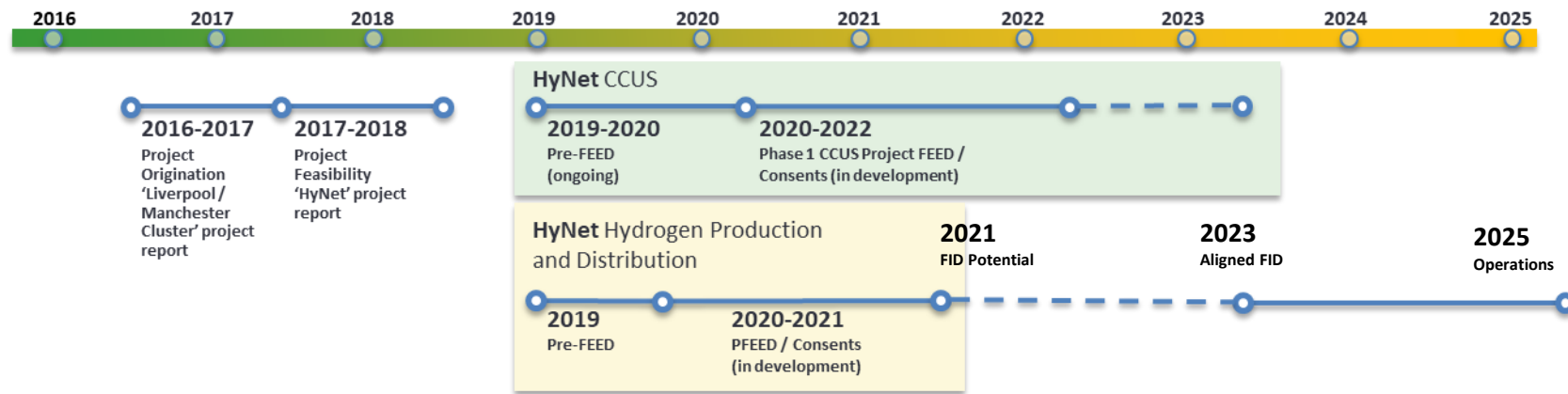


Swindon Technology Reference



absl
advanced biofuel solutions Ltd

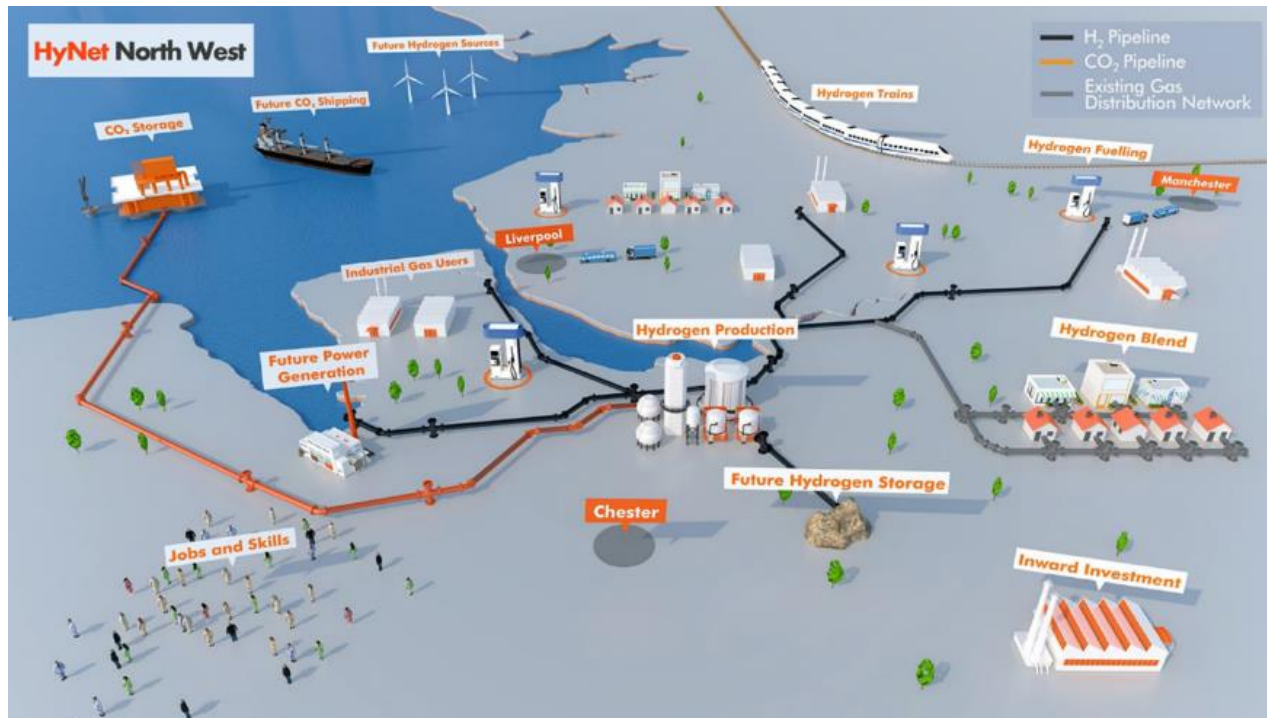
Deliverability: HyNet can be operating by mid-2020



Excellent development Support
from BEIS
Policy regime in development for
implementation

- CCUS infrastructure
- Industrial decarbonisation
- Hydrogen production
- Hydrogen distribution and blending

HyNet: Delivering Sustainable Economic Growth



Creating Jobs

- 6000 in NW and unlocking 75,000 in UK industry

Safeguarding industry and securing inward investment

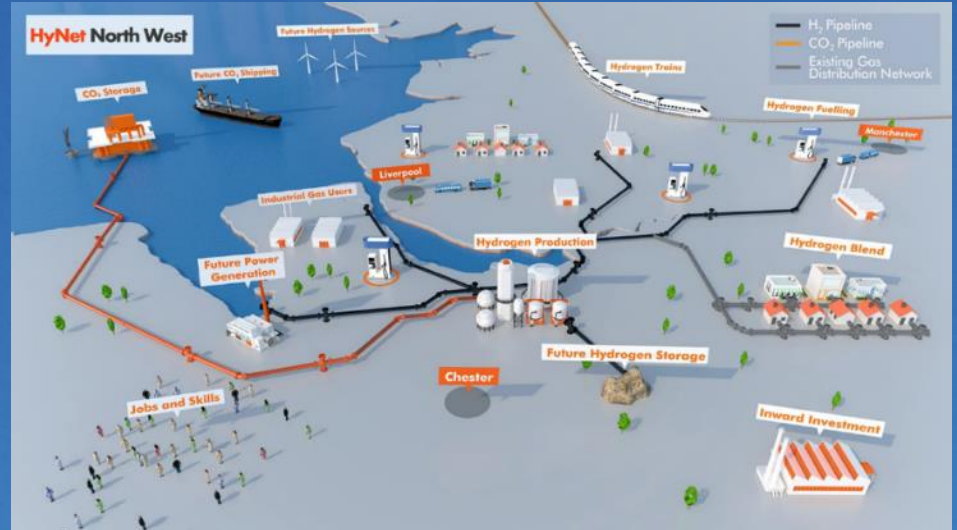
- £31 billion of GVA

Developing Exportable skills and services

- Exploiting UK offshore & chemicals industry leadership

An economically sustainable path to Net Zero with CCS & H₂

- 10 Mtpa CO₂ savings by 2030



We can solve it