



Low Carbon Agriculture 2022

Biomethane and Carbon Capture for Carbon Negative Farming

(and become a H2 Farmer)

8th March 2022

John Baldwin
Managing Director
CNG Services Ltd

john.baldwin@cngservices.co.uk
www.cngservices.co.uk
07831 241217

Low Carbon
Agriculture 2022



+44 (0) 1293 854405

info@lowcarbonagricultureshow.co.uk

www.lowcarbonagricultureshow.co.uk

[f](https://www.facebook.com/lowcarbonagri) [i](https://www.instagram.com/lowcarbonagri) [y](https://www.youtube.com/lowcarbonagri) [in](https://www.linkedin.com/company/lowcarbonagri) @lowcarbonagri | #lowcarbonagri

CNG Services Ltd

Low Carbon Innovations

cng services Ltd

Over the next 20 years, CSL's projects will contribute towards a CO₂ emissions saving of.....

17,500,000 tonnes

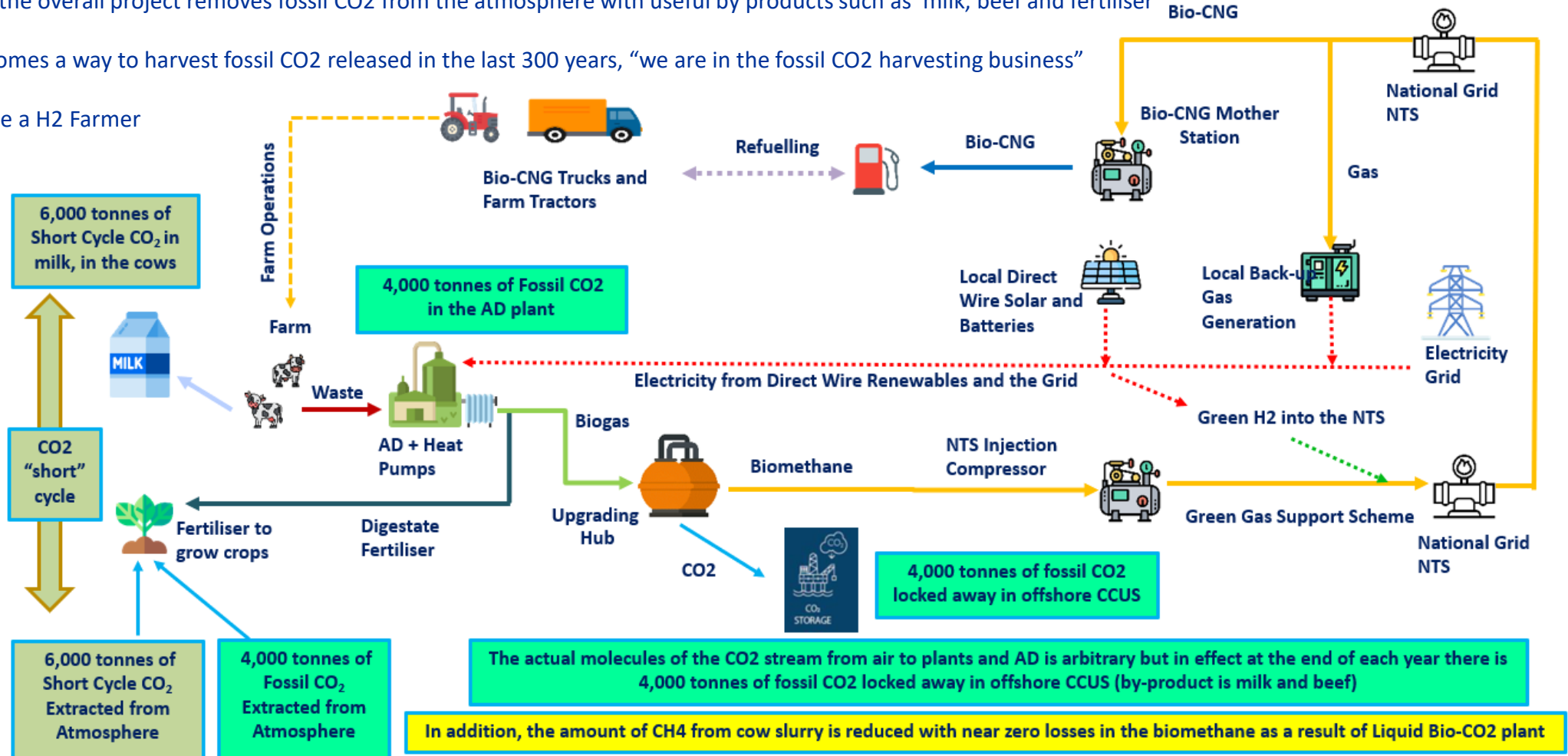
Celebrating over 16 years of innovation in gas

- CNG Services Limited (CSL) provides consultancy, design and build services to the biomethane industry, all focused on reducing Greenhouse Gas (GHG) emissions
- In the past 10 years our efforts have produced a material impact with an estimated 20 year project life reduction in CO₂ emissions of 17,500,000 tonnes through:
 - Biomethane injection into the gas grid
 - Running trucks on Bio-CNG
 - Acting as developer and design and build contractor for the Highlands CNG Project
- Part owner of CNG Fuels Ltd, a company set up to build a national network of Bio-CNG stations on the high pressure grid
 - National network of CNG Stations
 - 84% saving in GHG compared to diesel
- Part owner of Barrow Shipping Ltd, GB's leading shipper of biomethane and a company that only buys and sells biomethane, no fossil gas
- CSL is an ISO 9001, 14001 and 45001 approved company and has also achieved Achilles certification. CSL is GIRS accredited for design and project management and has been certified as a competent design authority by DNVGL
- Working on a number of H₂ and CCUS innovation projects including Green H₂ into the NTS



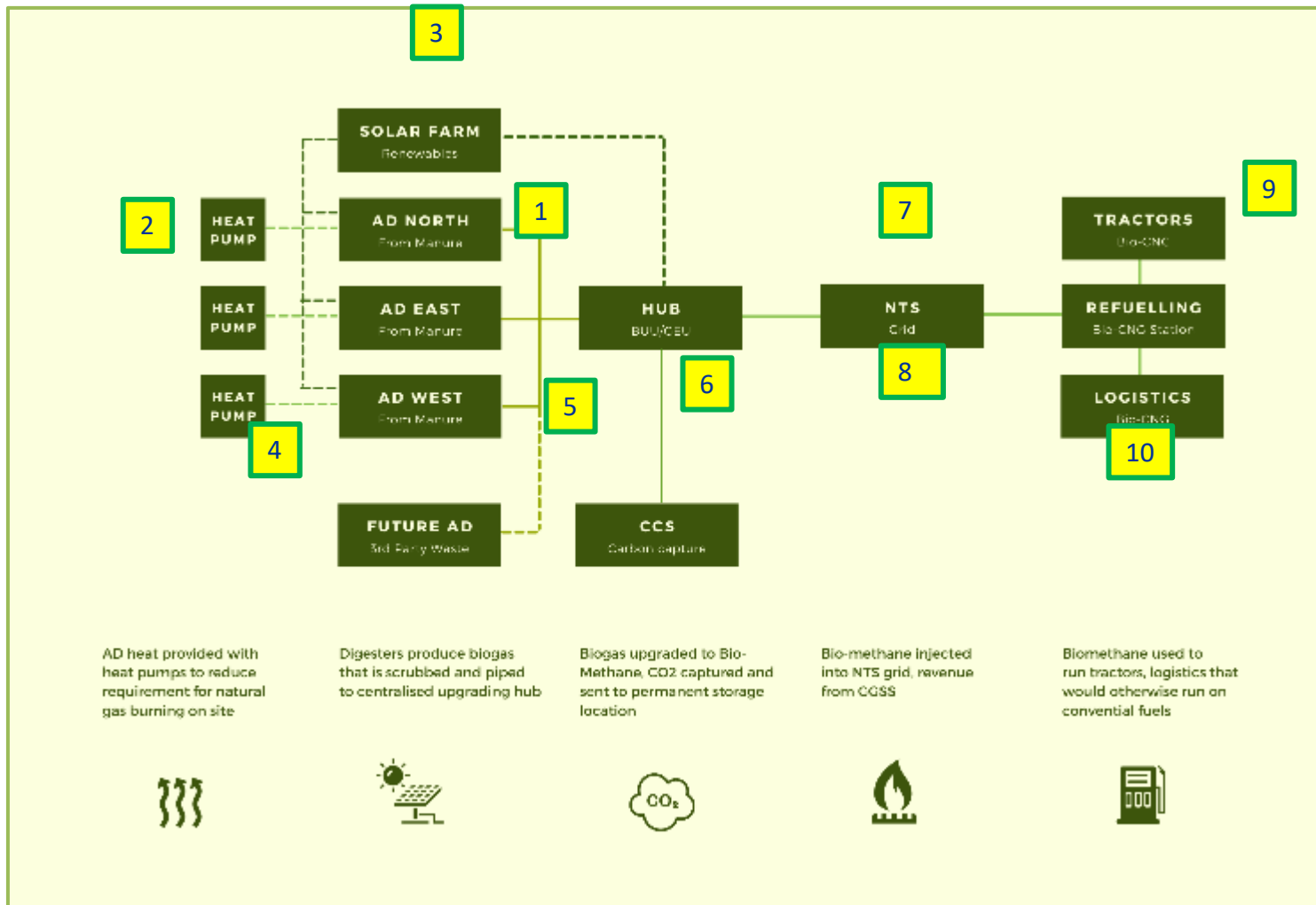
Biomethane and Carbon Capture for Carbon Negative Farming

- The production of biogas from anaerobic digestion is an established technology for manure
- The new innovation is capturing the Bio-CO₂ produced in the digesters as part of the biomethane production process and sequestering this Bio-CO₂ in depleted gas fields
- In this way the overall project removes fossil CO₂ from the atmosphere with useful by products such as milk, beef and fertiliser
- A farm becomes a way to harvest fossil CO₂ released in the last 300 years, “we are in the fossil CO₂ harvesting business”
- And become a H₂ Farmer



Carbon Negative Agriculture

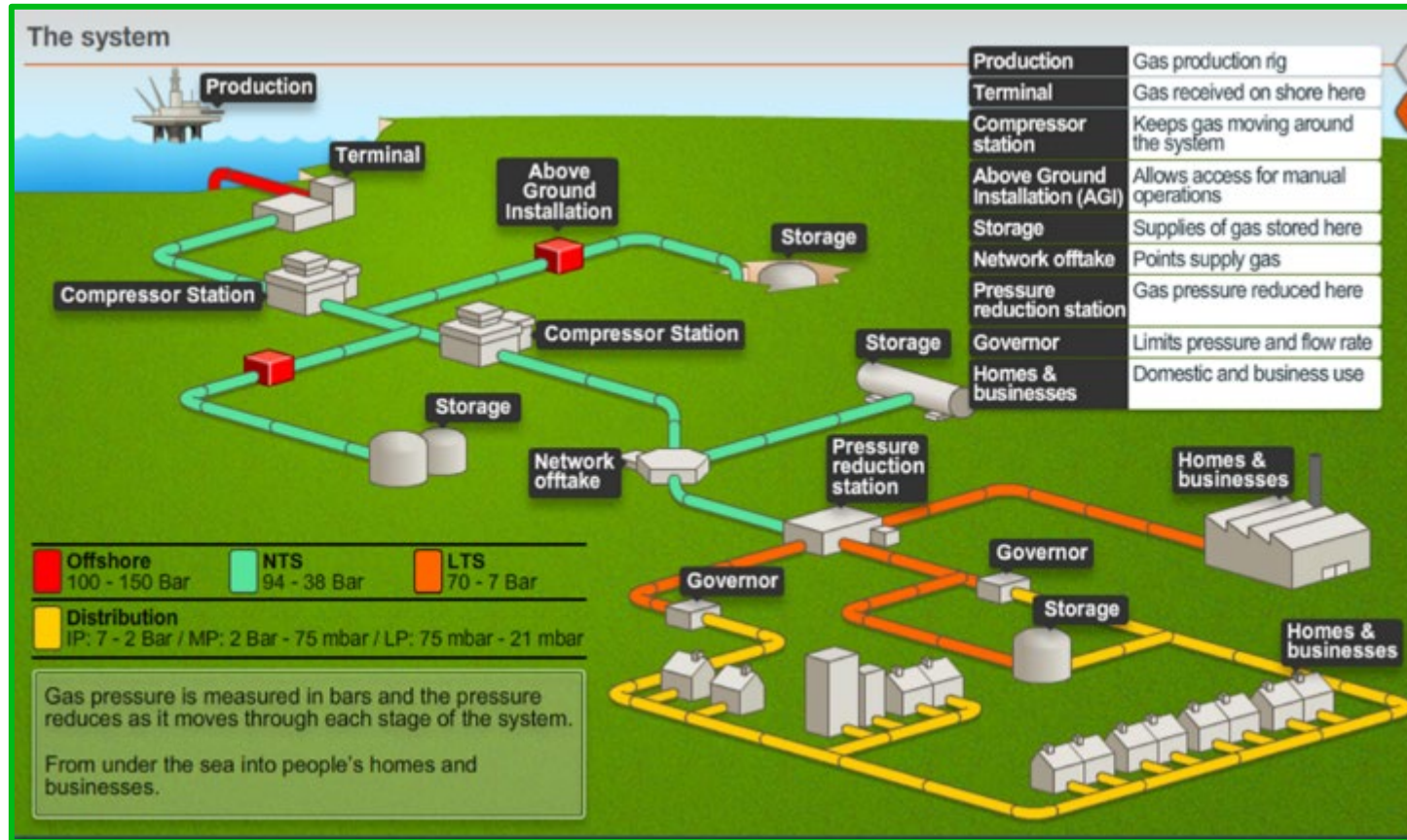
Cheshire Project with 10 NetZero Innovations



NetZero Innovations:

1. AD using manure (with no biogas combustion for heating and no biogas CHP)
2. AD heated using renewable electricity and heat pump
3. Direct wire network for ADs supplied by solar farm plus Electricity Grid back up
4. Pelletised fertiliser made from digestate and waste CO₂
5. [50] km of dry biogas pipeline network (2 bar) with Gas Transporter T licence linking [10] ADs
6. Upgrading and injection hub with liquid Bio-CO₂ from manure to be sent to CCS (e.g. HyNet)
7. NTS hot tap connection with innovative National Grid approach to compound size and design
8. Make Green H₂ and inject into the NTS
9. Farm tractors running on Bio-CNG made from manure with CCS – the lowest GHG fuel on planet earth
10. Bio-CNG made available via NTS Mother station and Mobile Refuelling Unit (MRU) model with circular economy – waste into the AD plants and Bio-CNG (and Bio-CO₂ ahead of CCUS) in return

GB Gas Network and the NTS



- **MP**
 - Lowest pressure tier used
 - Very high coverage across UK
 - PE or metal construction
 - 50 biomethane projects
- **IP**
 - 6.9bar Good coverage across UK
 - PE or metal construction
 - 40 biomethane projects
- **LTS**
 - Ranges from >12bar to 70bar
 - Usually 19 bar or 38 bar systems
 - All metal – however new high pressure PE up to to 100 bar is now approved
 - 25 biomethane projects
 - Ideal for Bio-CNG (e.g. CNG Fuels Leyland/Erdington)
- **National Transmission System (NTS)**
 - 50 – 85 bar
 - 1 biomethane injection and 1 Bio-CNG Mother station

NTS Key Points:

- NTS has no need for propane and avoids having to flare gas at start up (in the distribution network propane has to be added, this cannot be recycled as would contaminate the Bio-CO2 and so flaring has to take place when the plant starts)
- NTS great for making Bio-CNG as already has 60 bar pressure (climbing Everest starting at 26,000 ft)
- NTS great for back-up generation for the Dunkelflaute as no capacity issue and saves on gas transportation charges
- NTS ideal for H2 injection (see next slide)

Upgrading and Injection Hub with Liquid Bio-CO₂ sent to CCS

Key Points:

- Bio-CO₂ separated from the biogas using membrane technology
- Zero CH₄ to air as a result of the liquid Bio-CO₂ plant
- Biomethane compressed to 75 barg and injected into the NTS
 - No propane or odorant required
 - No capacity issue in the NTS
 - No need for flaring of reject gas on plant start up
- The biogas waste CO₂ is liquefied and sold into food and drinks industry or sent to CCS facilities for permanent sequestration
 - E.g. Hynet, next slide



The Air Liquide CO₂ Tanker is an Existing Food Grade Example

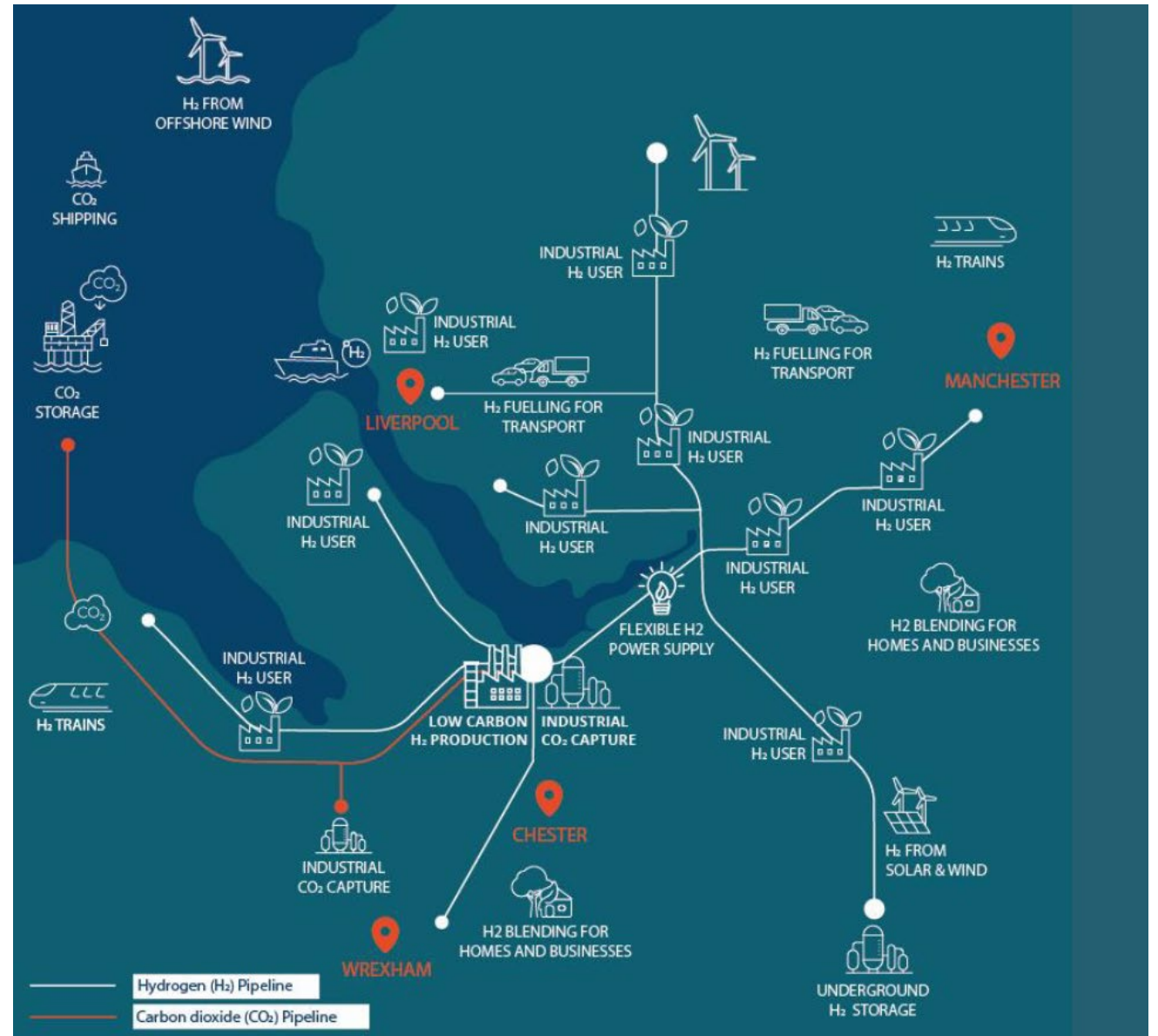
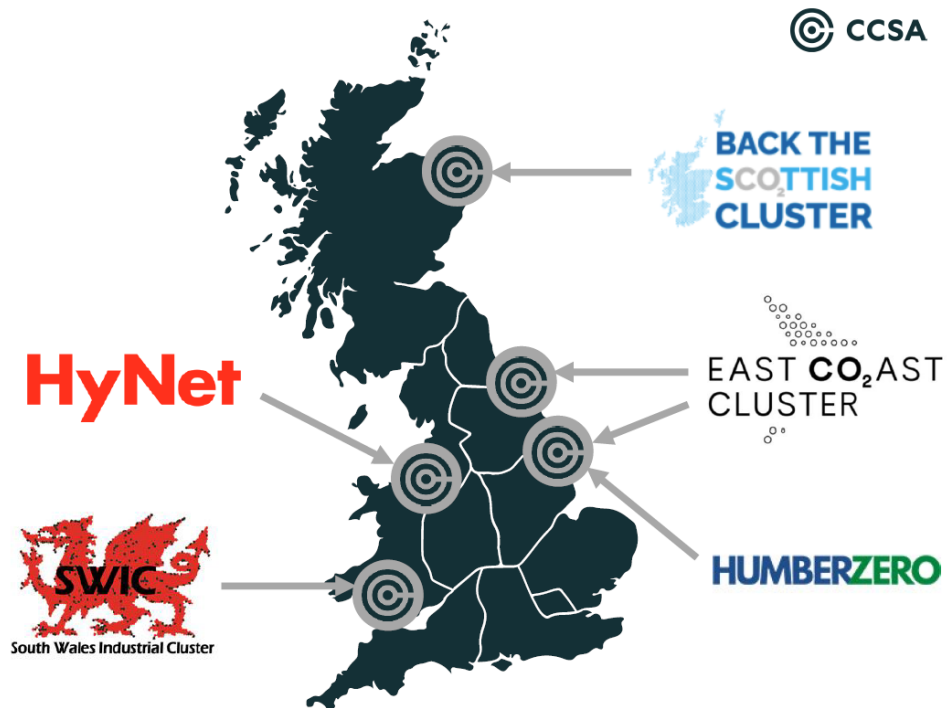


Photos from the first NTS Biomethane Injection Project at Somerset Farm Murrow Completed in 2020

HyNet CCS

Key Points:

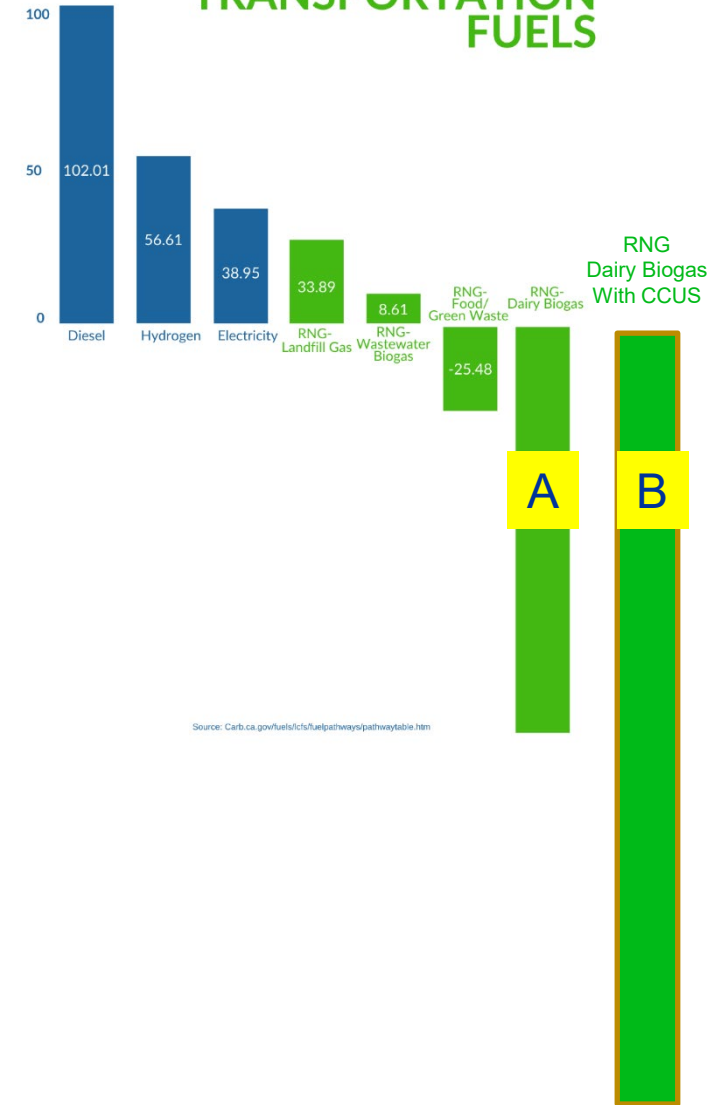
- Liquid Bio-CO₂ delivered in tankers from the Biomethane plant to the CCUS facility
- Target 2025 (may be 2024 for Future Biogas Northern Lights)
- Ahead of that, there are attractive market options for Bio-CO₂ in the food and drinks industry
- Advantage of the CO₂ sequestration is that it removes CO₂ from the atmosphere which is CO₂ negative
- In addition to Hynet there are other plants below



CO2 Impact – The Best Farm Tractor and Truck Fuel on Planet Earth

- The carbon intensity of transportation fuels consider the origin of the gas, the required processing to take it from a raw material to a delivered fuel and the exhaust emissions. This is also known as the ‘Well to Wheel’ emissions
- Biogas produced from an organic feedstock has a low carbon intensity since the feedstock does not contribute to the net amount of carbon in the atmosphere, as it has been recently removed (short cycle)
- Biogas produced from dairy waste (i.e. cow slurry) has a net negative carbon intensity by eliminating methane emissions that would otherwise enter the atmosphere if it was not captured
- The graph on the right illustrates that in California, dairy biogas is considered to be carbon negative and highly attractive to be used as a vehicle fuel (Renewable Natural Gas, RNG). Column “A” assumes the biogas CO2 is vented off.
- The farm tractors and trucks exist, can be bought off the shelf, see below
- For projects capturing this CO2 and sending for CO2 sequestration which would mean it is significantly more carbon negative and shown as Column “B”. This is the best fuel for farm tractors trucks on planet earth
- Projects starting in 2022- 24 can sell Bio-CO2 to industry and then send to CCS in 2025 to deliver maximum CO2 benefit to the farm
- A farm becomes a way to harvest fossil CO2 released in the last 300 years, we are in the fossil CO2 harvesting business
 - That plus becoming a Hydrogen farmer (see later) is a great place to be

CARBON INTENSITY RATING OF KEY TRANSPORTATION FUELS



Source: Carb.ca.gov/fuels/icts/fuel/pathways/pathwaytable.htm



Become a H₂ Farmer - Green H₂ injection into the NTS

The potential for Green H₂ into the NTS

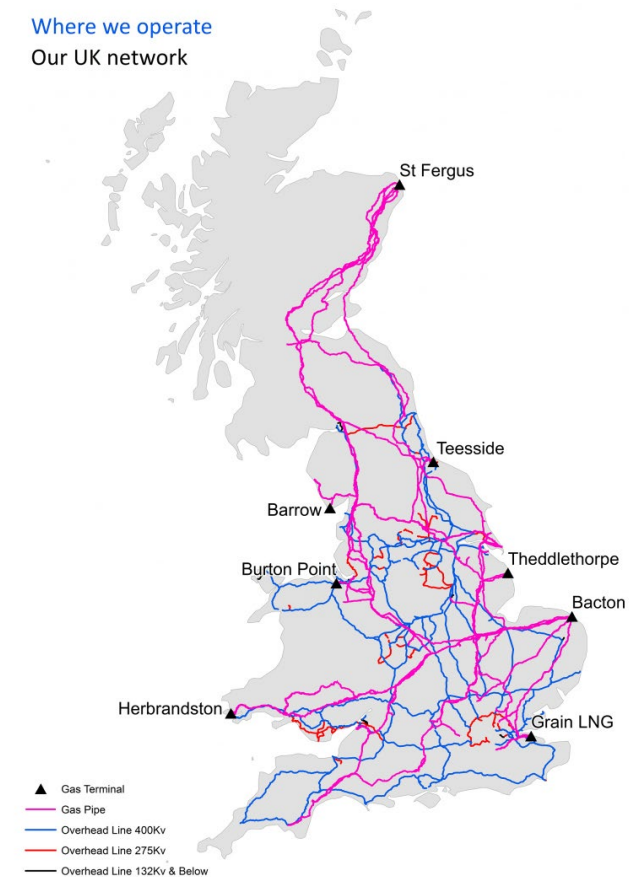
- There is material potential to reduce CO₂ emissions by injecting H₂ into the National Grid Gas (NGG) National Transmission System and displacing natural gas
- NGG are progressing studies with the support of the HSE to allow potential of 5% H₂ by 2025
- The NTS provides flexibility to inject H₂ and not go outside any Calorific Value limits
- To put that in context, 5% H₂ by volume is equal to around 16 TWh/annum of H₂. After 10 years there is around 6 TWh/annum of biomethane and so having the flexibility to add this much H₂ would be a great way to start the market

A typical Green H₂ project

- A 3 MW electrolyser using renewable electricity will produce a maximum rate of around 450 scmh of H₂ which would be 14 million kWh of H₂ in a year (assuming 65% efficiency and 80% load factor). The renewable energy can be produced from wind, solar and batteries
- In Germany Greenpeace Energy sells Green H₂ injected into the Transmission Grid in Northern Germany to natural gas consumers in Berlin, with a Guarantee of Origin system linking the kWh off Green H₂ injected to the kWh of natural gas consumed. This NGG project aims to develop this option for UK consumers
- 16 TWh/annum of Green H₂ would represent 1,136 projects sized at 3 MW or 110 projects at 30 MW. Busy farmers!
- CSL working for National Grid Gas on a Ofgem Strategic Innovation Project to establish the rules for H₂ injection and to get this market moving, full details here:

https://www.cngservices.co.uk/wp-content/uploads/Green-H2-SIP-CSL-Press-Release-4th-March-22_FINAL.pdf

Where we operate
Our UK network



NTS Hot Tap

Conclusions

- NetZero is hard for agriculture. However, there is a carbon negative opportunity:
 - Use of farm waste to make biomethane is proven and deliverable
 - Reduced CH₄ emissions from slurry into AD is valuable
 - Locking away the Bio-CO₂ makes the project double Carbon negative and farmers can start to harvest fossil CO₂ and lock it away
 - Biomethane is very valuable at today and likely forward gas prices
 - Fertilizer has around 3 x the value post AD compared to slurry
 - Running trucks and farm tractors on Bio-CNG biomethane is feasible today as the vehicles exist, the fuel exists and the tax and incentive regime in GB is attractive
 - And there are now great Bio-CNG filling stations like the new one in Avonmouth opened last week by CNG Fuels
- Farmers with an NTS Pipeline across their land also have an opportunity with solar/onshore wind and batteries to make H₂ and inject it into the NTS



Remember the Golden Rules - NEVER burn any biogas, NEVER vent any CO₂, NEVER vent any methane and NEVER use diesel
And if you are lucky, become a H₂ farmer