Bio-CO_2 market potential

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ADBA | Anaerobic Digestion and Bioresources Association

Key barriers to deployment of carbon capture at biomethane plants

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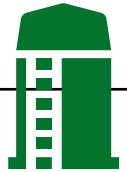
REA GREEN GAS

Background

Established energy market
+
Policy support for green gas production

Organic feedstock
Food waste
Livestock waste
Bioenergy crops
Wastewater

Anaerobic digestion
AD



Biogas

Upgraded to…
aka split into component parts

~60% Biomethane

- Chemically identical to natural gas
- Suitable for grid injection, heat or transport fuel

~40% Bio-CO_2

- High concentration CO_2 stream
- Created as a **by-product** of biomethane generation

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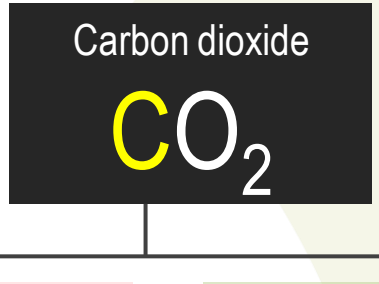
Terminology



Fossil

Originating from fossil resources

Carbon is derived from geological stores, where it has been locked away from the atmosphere for millions of years.

Release of fossil-CO_2 contributes to greenhouse gas emissions

Biogenic

Originating from living organisms

Carbon is derived from atmosphere, where CO_2 is absorbed by plants during photosynthesis.

Release of bio-CO_2 does <u>not</u> contribute to greenhouse gas emissions – it is 'carbon neutral'

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Current CO_2 demand

UK industry use:
~600,000 tonnes CO_2 per year

CO_2 gas is a produced as a by-product of artificial fertiliser production.

Around 60% of this gas demand is supplied by two *CF Fertiliser* factories producing ammonium nitrate:

- Billingham, Teesside *(largest supplier)*
- Ince, Cheshire

Most of the remaining gas is supplied by:

- Nippon's fertiliser plant in Rotherham
- Ensus' bioethanol plant in Teesside

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CO_2 market

Two variables primarily govern the price of industrial CO_2:

1) **Proximity to CO_2 production**
   Gas is transported by road to industrial users, where trucks typically return to production sites empty (to prevent tank contamination from other gases)

2) **Cost of natural gas**
   High levels of natural gas are required to manufacture fertilisers – when its price increases, so does the cost of artificial fertilisers *and* CO_2 gas

The current gas crisis has suspended fertiliser production, resulting in the <u>current CO_2 crisis</u>

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Bio-CO_2 production

Bio-CO_2 gas is a produced as a by-product of biomethane production.

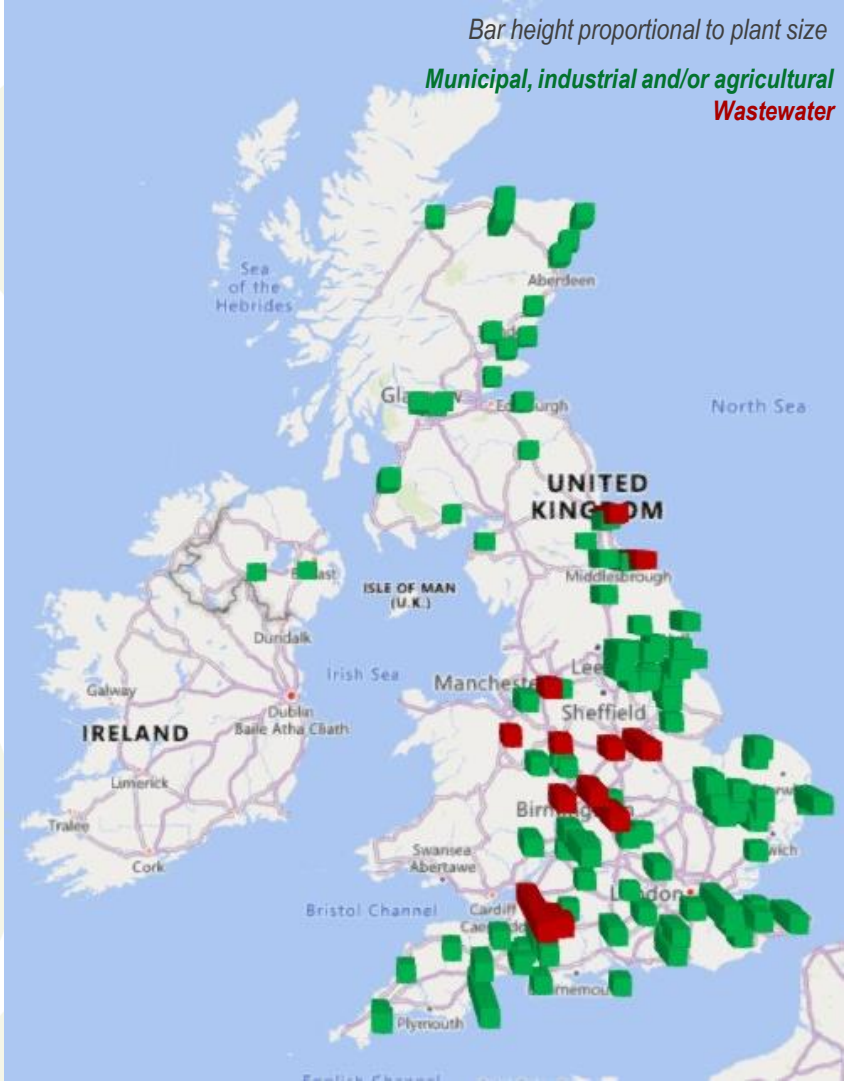
Today, 122 biomethane plants in the UK:

110 plants treat municipal, industrial and/or agricultural feedstocks

Total bio-CO_2 production = 1,064,000 tonnes pa
Average plant production = 9,490 tonnes pa

12 plants treat wastewater

Total bio-CO_2 production = 138,000 tonnes pa
Average plant production = 11,315 tonnes pa



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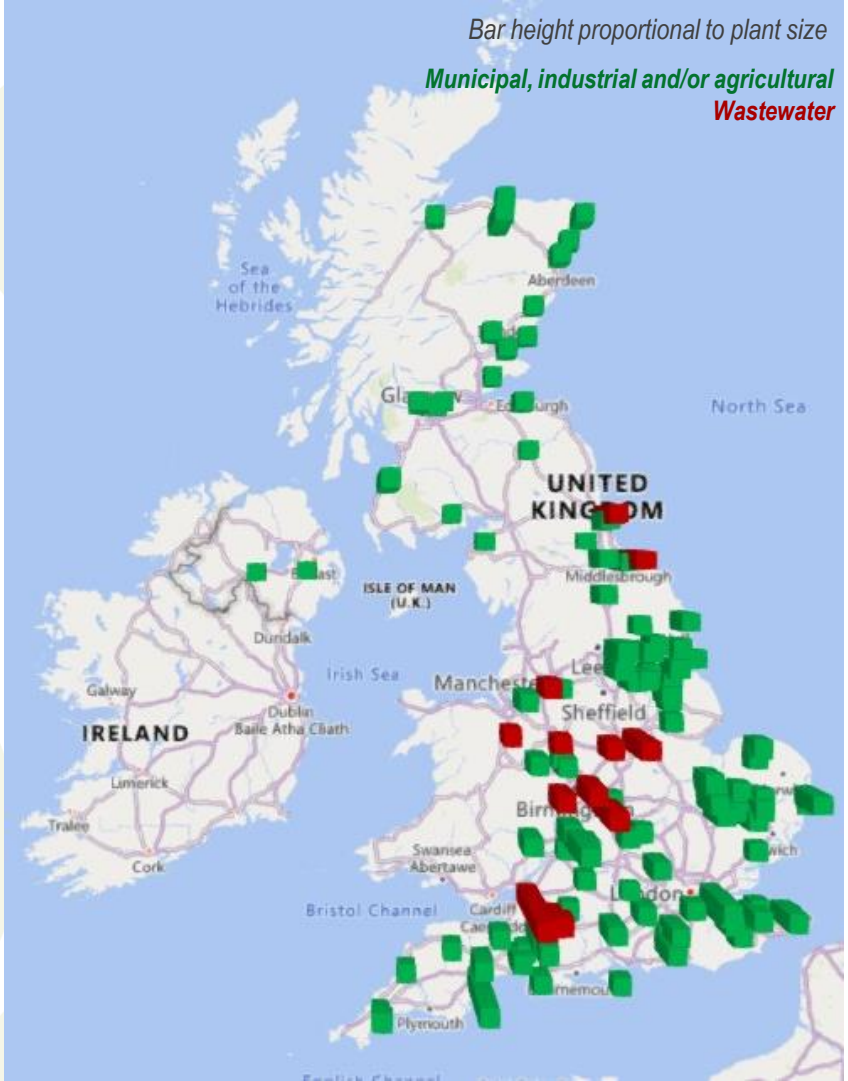
Bio-CO_2 production

Bio-CO_2 gas is a produced as a by-product of biomethane production.

Today, 122 biomethane plants in the UK:

Total bio-CO_2 production
1.2 million tonnes

Total CO_2 demand
0.6 million tonnes



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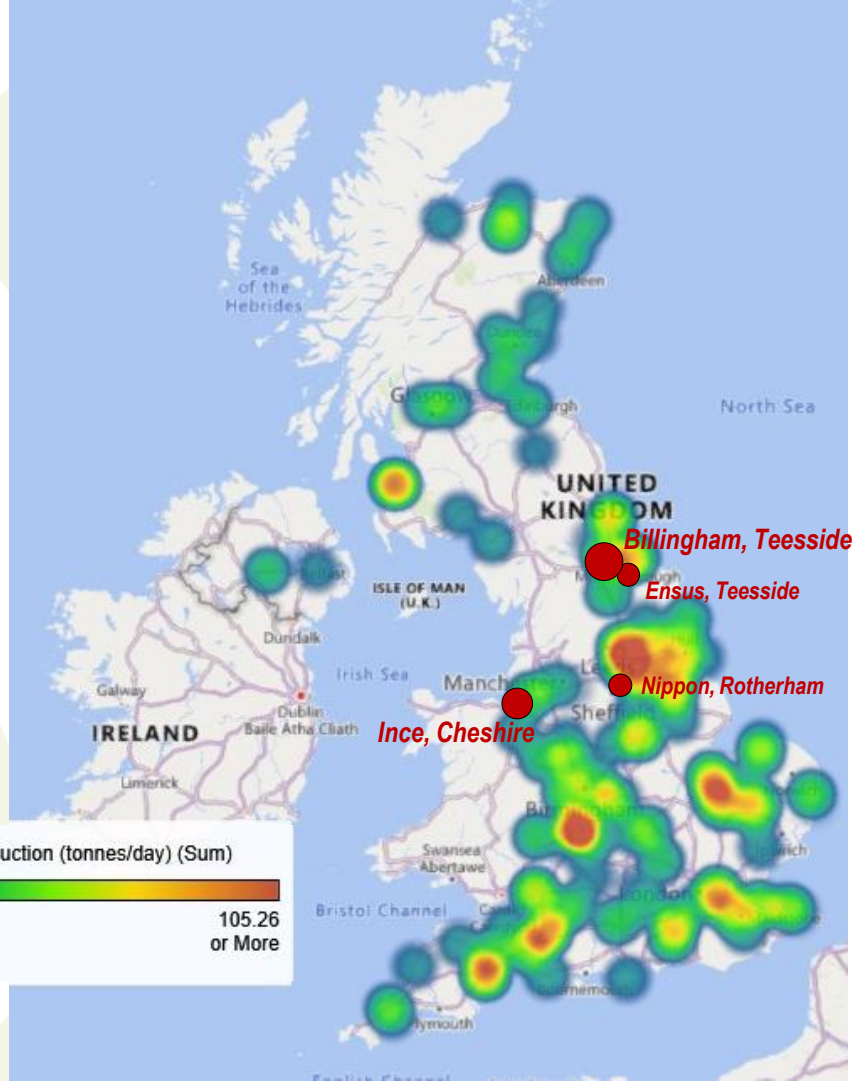
UK distribution

*AD plants offer a **decentralised supply** of bio-CO_2*

Coloured areas on the map display all locations within a **25km radius** of every biomethane plant in the UK.

Locations in red could source 100+ tonnes of bio-CO_2 per day from local AD infrastructure.



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Transportation

Each gas transportation truck can hold around 20 tonnes of compressed CO_2.

This map displays all locations within 25km of a biomethane plant capable of fill at least one truck per day

In total, 78 biomethane could fill at least one truck per day.

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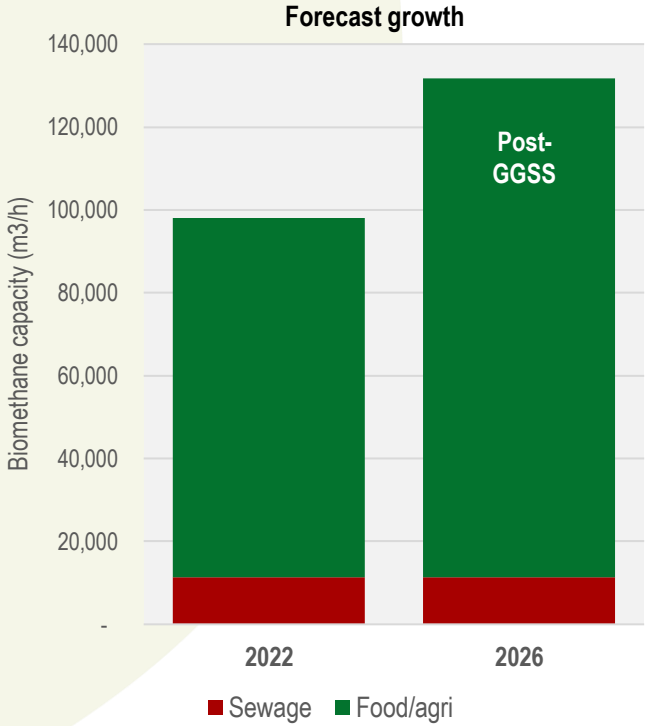
Green Gas Support Scheme (GGSS)

In November 2021, BEIS launched the GGSS. This scheme rewards the production of biomethane from AD plants through a fixed tariff rate (p/kWh), secured for 15 years.

Before the end of 2025, the GGSS is forecast to:

- Support the construction of **~45 new plants** with an average biomethane capacity of >750 m^3/h
- At this size, each plant would produce around **9,200 tonnes bio-CO_2 per year** (25 tonnes per day)

It is expected most of these plants will deploy upgrading technology capable of producing **food-grade CO_2**



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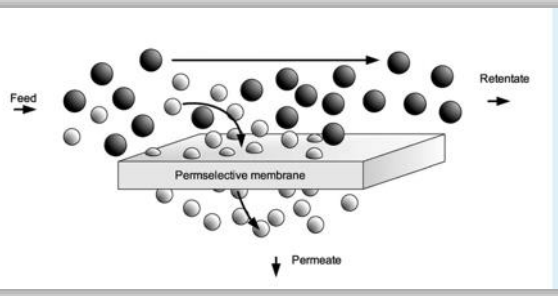
Current deployment

Just **11 biomethane plants** currently capture bio-CO_2 from the biogas upgrading process.

These plants supply around **80-90,000 tonnes bio-CO_2** to industry per year (~15% demand).

The remaining >1Mt of bio-CO_2 currently being produced is vented to atmosphere…



Context

- At the end of last year, in the wake of ongoing CO_2 supply issues in the UK, BEIS reached out to the green gas trade associations seeking feedback on the key barriers to deploying carbon capture at biomethane plants
- Key issues identified by our members were mainly:
  - Market perception towards waste-derived CO_2
  - Cost of installing and running carbon capture technology

Negative market perception of waste derived CO_2

The Air Liquide CO_2 Tanker is an Existing Food Grade Example (Not Manure)

- Limited market acceptance for **waste derived liquid CO_2** from food & beverage companies:

  - ✓ Entirely due to perception - waste derived CO_2 can meet the same spec (Food-grade CO_2) as non waste CO_2.
  - ✓ Middle size industry not particularly concerned, it's mostly the big companies (e.g. Coca Cola) that have an issue
  - ✓ This attitude is in contrast with Government policy which aims at encouraging more biodegradable wastes to AD, diverting them from landfill and supporting a Circular Economy. In other markets (e.g. green gas certificates), companies pay a higher premium for biomethane derived from wastes.

Economics

- **High capex** of installing / retrofitting a CO_2 liquefaction plant:
  - ✓ Unit production costs are significantly higher compared to large scale fertiliser plants due to limited economies of scale. Scale is an important factor as biomethane installations are typically not large enough, nor produce enough $CO_{2,}$ to make the investment stack at current CO_2 market prices.

- **High opex**:
  - ✓ Running costs can be very significant due to the high-power demand from the equipment used to capture the $CO_{2.}$
  - ✓ Electricity is required for the CO_2 liquefaction process – estimated at an additional 0.1kWh/Nm_3 biogas processed

- **Limited number of bio-CO_2 offtakers** - there is limited price competition:
  - ✓ Some CO_2 companies have pulled out from the sector or were not interested in the first place because they regarded production at each facility as too small.

Other market / supply issues identified

- **Limited markets / applications** at present time:
  - ✓ Food and drink sector is the dominant market
  - ✓ Lack of technology readiness for CCS or CCUS technologies mean these applications are not available yet
  - ✓ For use in higher value market such as horticulture, large mismatch between supply (constant) and demand (seasonal) make these applications more difficult
  - ✓ Tankers cannot mix 'food grade' with lower grade CO_2 even on consecutive loads. So supply and transportation of lower grade requires dedicated transporters, which are expensive.

Image from Biocarbonics

Thank you

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