TROVE Renewables

1st Subsurface

# Screening CO2 Storage Sites – North Sea+

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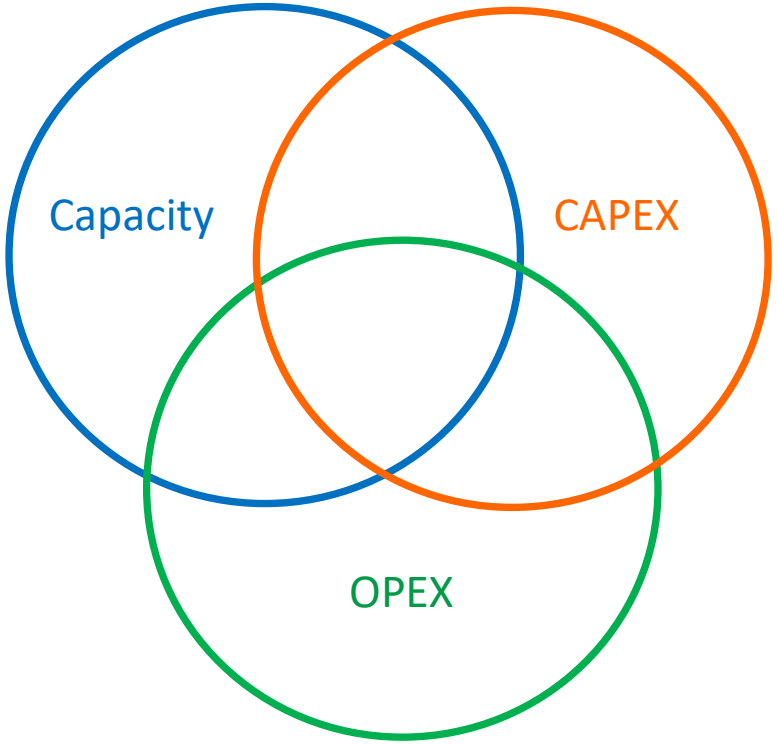
# Selection of the ‘best’ site for CO2 storage

Firstly all sites need to pass a ‘store integrity’ test.
After that the selection process needs to optimize three high level criteria.

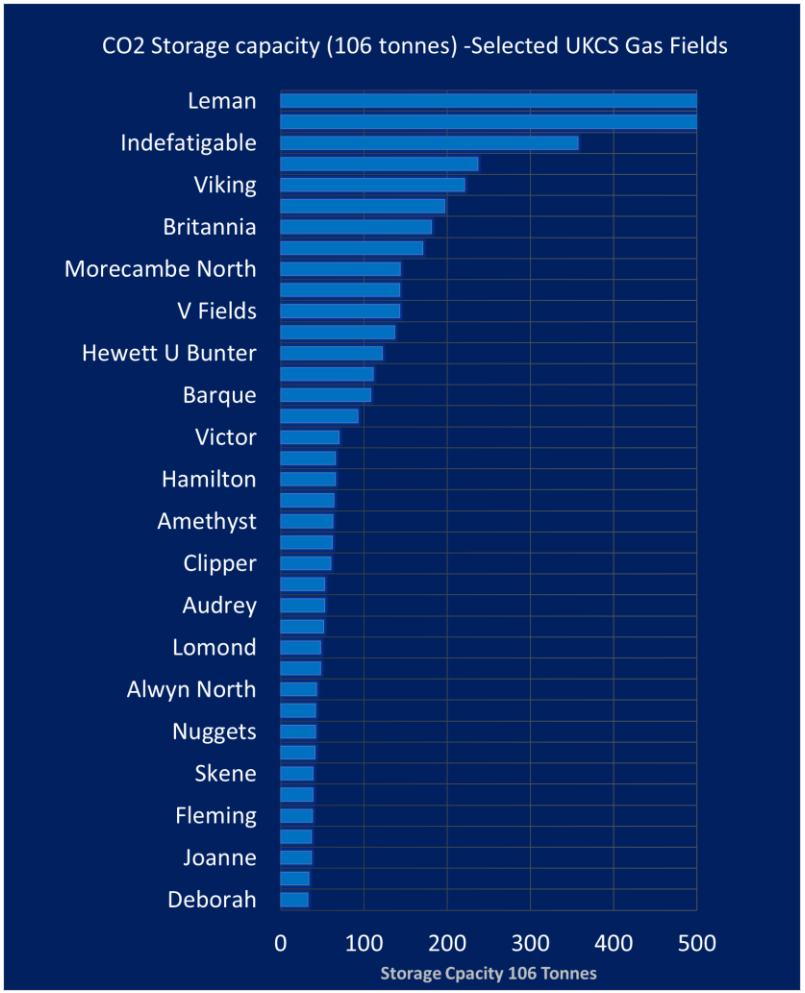
How much CO2 do you want to store?

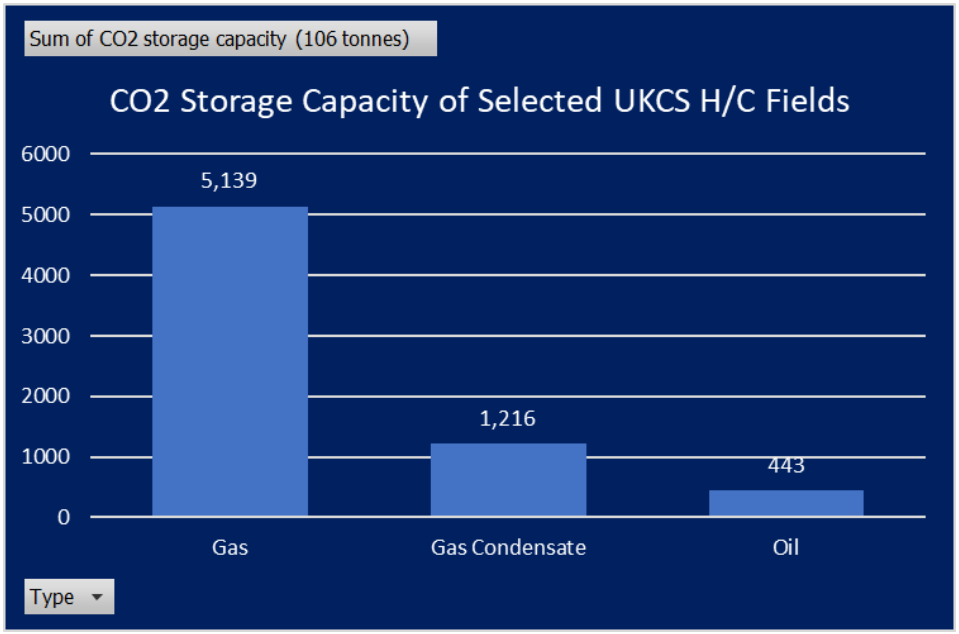



New build / re-purpose existing O&G infrastructure

Separation, transportation and injection of CO2

# Plenty of Gross Storage Capacity



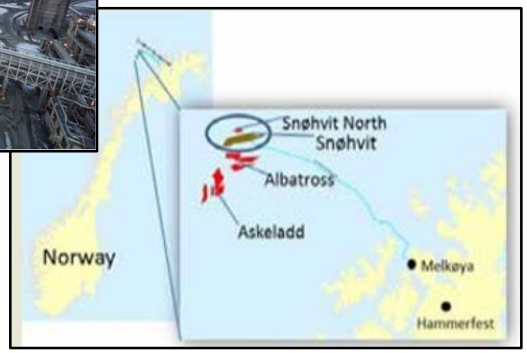

- > 6 GT in UKCS Gas/Condensate Fields
- 25 GT in NW Europe H/C Fields
- 800 GT offshore NW Europe (H/C Fields & Saline Aquifers)

Most H/C fields and aquifer structures can be considered valid storage sites candidates unless compromised in some way by H/C development.



Data examples selected from CO2STOP database, BGS publications and 'Trove' databases

# Existing projects all exploit existing O&G infrastructure - Snohvit and Sleipnir





- Capture CO2 removed in processing raw gas to export specification.
- CO2 injected into aquifers immediately adjacent to producing fields.
- Limited or minimal CO2 transportation.
- Injection rates 0.7 -0.9 Mtpa.
- Aquifer Permeability - moderate to very good 300mD (Snohvit) 1-3D (Sleipnir)
- Aquifer capacity at current injection rates – decades to centuries.
- Limited requirement for retrofit CO2 infrastructure or built in from day 1.

Are these the best analogues for a storage site that may aim to capture a significant part of the CO2 from UK industry & Power Generation?

# What's the CO2 store for?
# - three analogues from the 'waste' business

'Own Garbage' - Plant / point source specific – relatively small annual volumes for life of plant eg Snohvit / Sleipnir

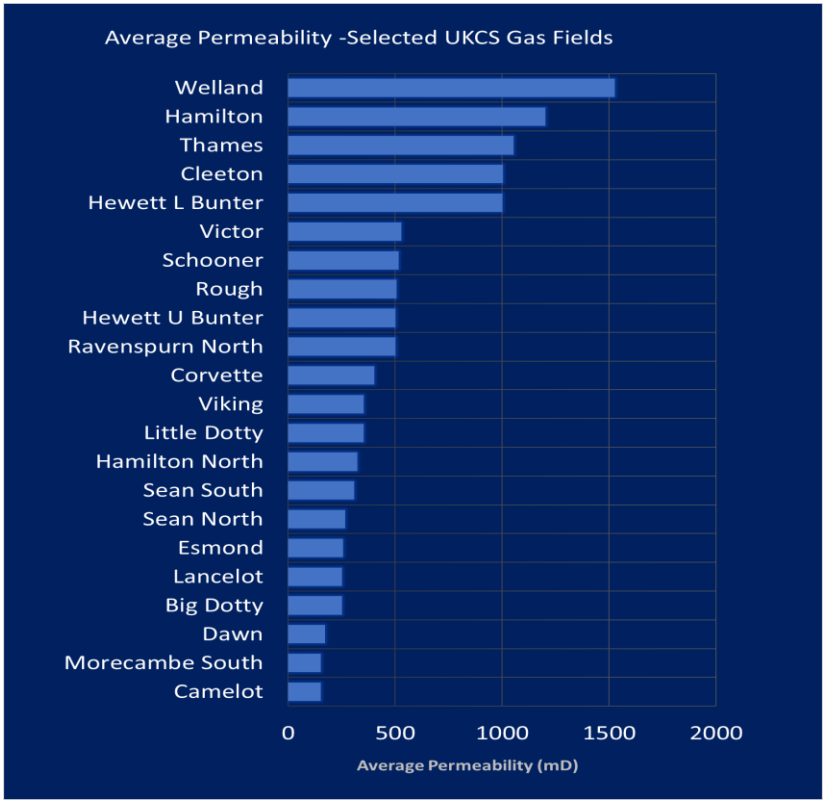
'Council Tip' – Several point sources in local area sharing a storage site eg Acorn

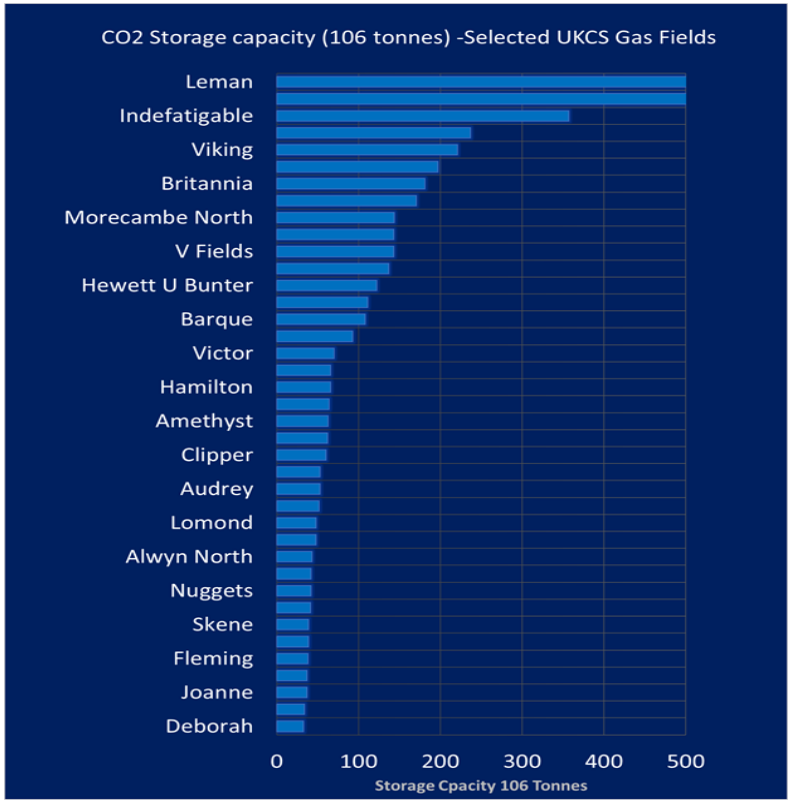
'National Infrastructure' – very big annual volumes gathered over a large area for decades eg Northern Lights

The business model and costs associated with the three examples is dependent upon the scale of the operation. We should expect a similar variation with CCUS. This may be further complicated by who 'pays' for CCUS and what the business model might be.

# OPEX for CO2 storage is going to be high

- Separation of CO2 from power station flue stacks is energy intensive and adds a material parasitic load to a power plant.
- The CO2 then needs to be compressed for transportation and injection into the subsurface.
- This is always going to be expensive irrespective of the technology used.
- Anything that minimizes compression requirements is critical. In subsurface terms this is reservoir injectivity. The bigger and longer the store is in use the more important this will become.
- In the absence of reservoir injectivity data 'average permeability' may the best proxy for the 'cost' of injecting CO2 into the subsurface.

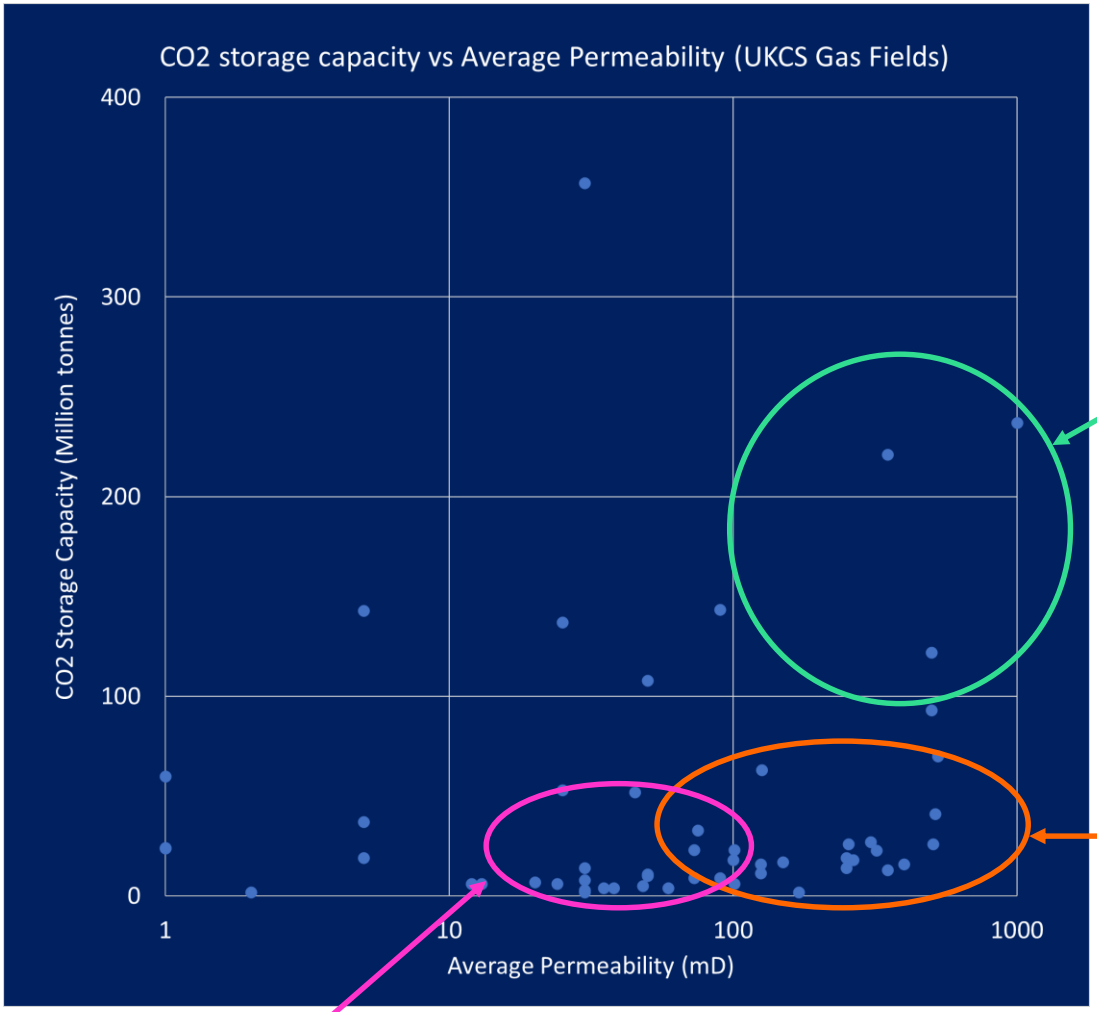





Data examples selected from 'Trove' databases

# Storage Site Selection – ‘Average Permeability’




High Volume / Hi Injectivity
-best for long life national infrastructure

Moderate Volume / Hi Injectivity
- Best for moderate life national infrastructure, ‘Council Tip’

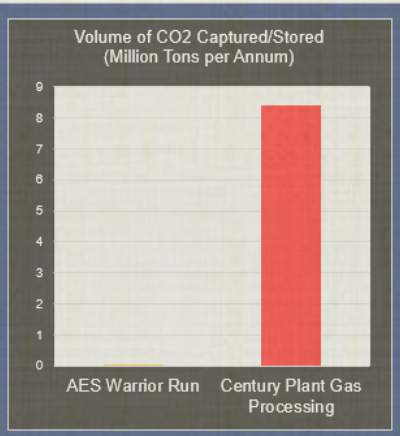
Moderate Volume / Moderate Injectivity
- ‘Sites of Opportunity’

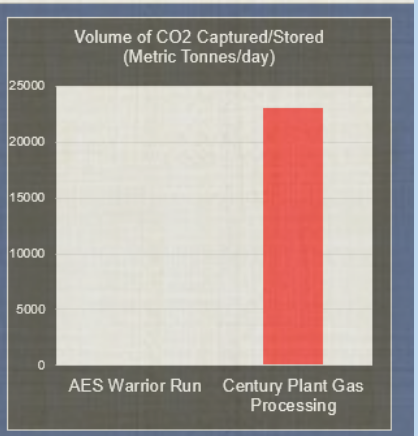


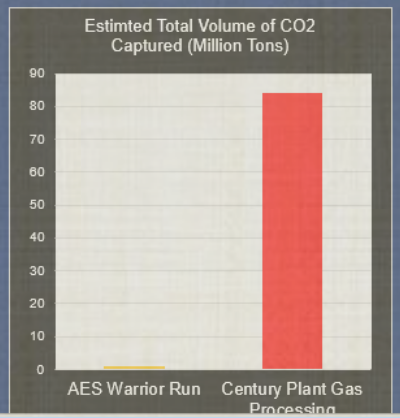
Data examples selected from ‘Trove’ databases

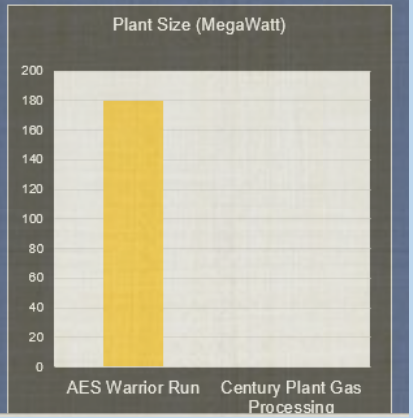
# THANK YOU

| | | Choose Asset | AES Warrior Run | Century Plant Gas Processing |
|---|---|---|---|---|
| CCUS Project | | Operator | AES Corporation | Occidental Petroleum |
| | | Country | USA | USA |
| | | State/ Region | Maryland | Texas |
| | | Capture and/or Storage | Capture | Capture and Storage |
| | | Project Scope | Capture Only | Capture & used for EOR |
| | | Commercial, Injection Pilot, Technology Demonstration, or R&D | Commercial | Technology Demonstration |
| | | Project Status | Operating | Operating |
| | | Project Phase | Capture Ongoing | Capture Ongoing |
| CO2 Source | | CO2 Source / Industrial Plant | Warrior Run Power Plant | Century Gas Processing Plant |
| | | Industrial Plant Type | Coal Fired Power | Natural Gas Processing |
| | | Industrial Plant Status | Existing | Existing |
| | | Plant Size (MegaWatt) | 180 | |
| | | Retrofit / New Build CO2 Capture | Retrofit | |
| | | Combustion /Seperation | Post-Combustion | Pre-Combustion |
| | | CO2 Capture Technology | Ethanol-Amino Solvent | UOP SELEXOL |
| CO2 Storage / Use | | CO2 Use / Storage Type | Industrial | EOR |
| | | Storage Location: Onshore / Offshore | | Onshore |
| | | Storage/ Capture Startup Year | 2000 | 2010 |
| | | Volume of CO2 Captured/ Stored (Metric Tons per Day) | 115 | 23014 |
| | | Volume of CO2 Captured/ Stored (Million Tons per Annum) | 0.0 | 8.4 |
| | | Estimated Total Volume of CO2 Captured (Million Tons) | 0.8 | 84.0 |

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Data examples selected from 'Trove' CCUS