

Morecambe Net Zero (MNZ): Monitoring Strategies and Technologies for a Carbon Storage Site

NSTA Technology Showcase

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Spirit Energy

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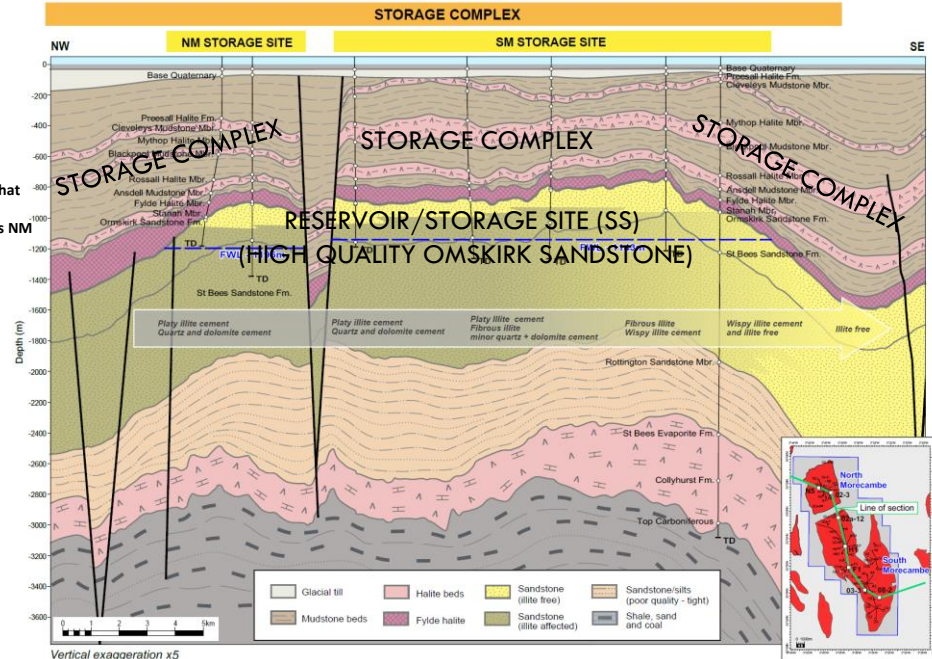
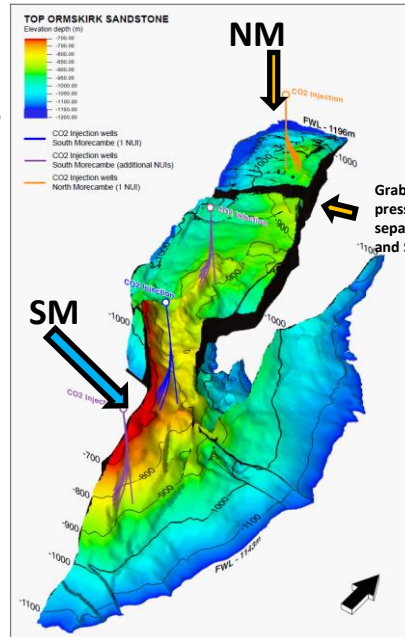
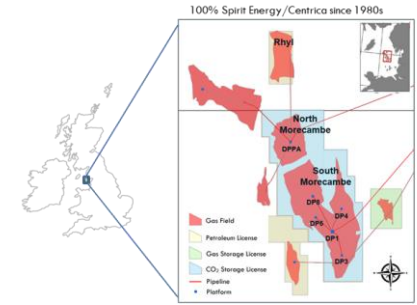
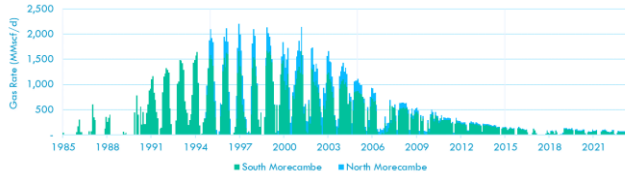


MNZ Storage Sites

- The Morecambe Hub is a cluster of highly depleted gas fields in the East Irish Sea approximately 25 km west of Barrow-in-Furness
- Carbon Storage Licence CS010 was awarded in 2023 UK licensing round
- Fault-bounded / dip-closed structural traps, pressure separated by a clear graben structure
- Primary CO₂ emitter: Peak Cluster



Over 6.6 tcf of natural gas produced to date; 5.4 tcf from South Morecambe 1.2 tcf from North Morecambe



The Seal/Overlying storage complex: Interbedded mudstones and halites providing excellent top seal integrity.

MNZ: Challenges and Key Technologies for Monitoring

Key Challenges for MNZ

1. Infrastructure

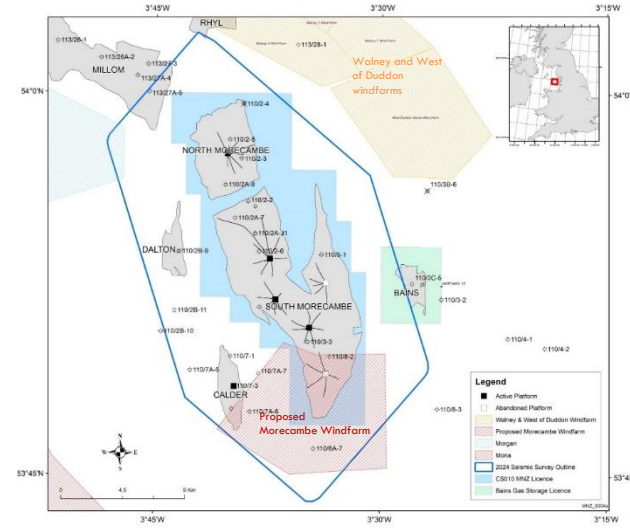
- Existing windfarms (Walney & West of Duddon Sands)
- Planned Windfarms (Morecambe, Mona & Morgan)
- Platforms (Spirit Energy & Harbour)

2. Highly depleted gas reservoir

- Highly depleted, $P \approx 10$ bar at injection start
- Acoustic response to CO_2 injection within the storage site is expected to be below detection limits
- EM response to CO_2 injection within the storage site is expected to be below detection limits

3. Size of storage sites

- Storage site area: 107sq km
- Storage complex area: 230sq km



Key technologies currently being assessed for MNZ

1. Baseline high-resolution seismic (Shearwater)
2. Time-lapse gravity (Reach Subsea)
3. Time-lapse seabed displacement (Reach Subsea)
4. S-DAS (NZTC research: slb)
5. Seismicity (BOPS)

Seismic Survey Requirements and Challenges

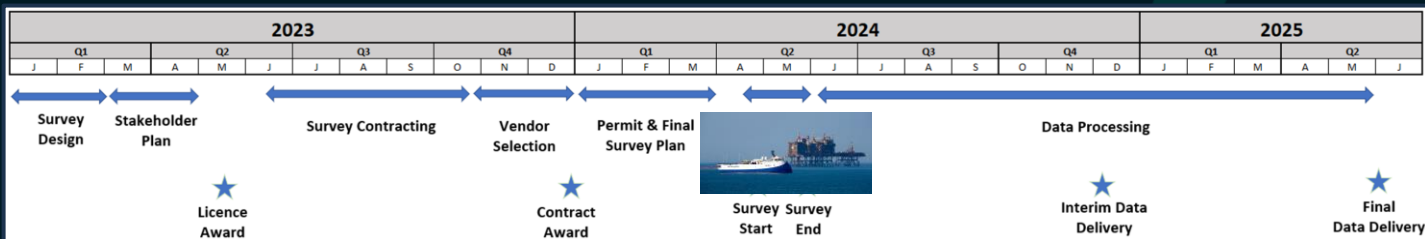
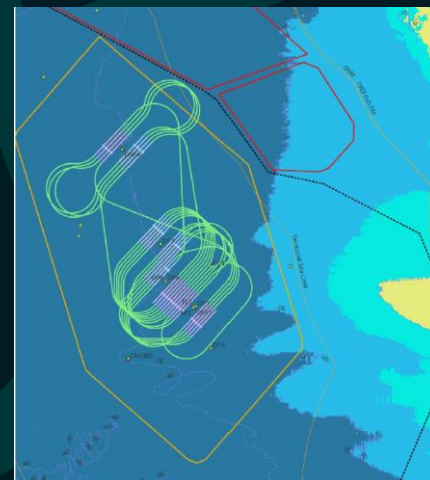
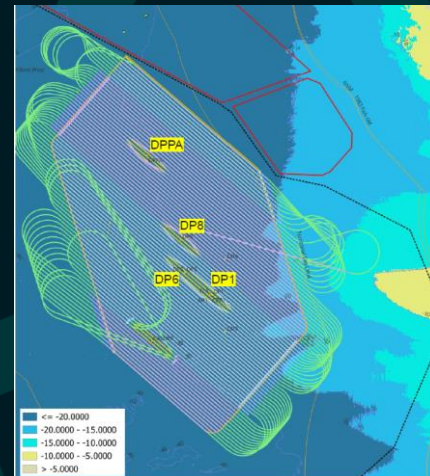
Key Requirements

- Site characterisation and potential future baseline (containment)
- Shallow imaging: Base Quaternary

Survey design	Gas production: 2008 Survey	Carbon Storage: 2024 Survey
Streamer spacing	4 x 100m (300m wide)	7 x 80m (480m wide)
Receiver spacing	25m	6.25m
Sensors	Pressure	Dual
Number of sources	2	4
Source point spacing	12.5	6.25
Source to streamer distance	160m	25m
Data points per sq km	307,200	640,000

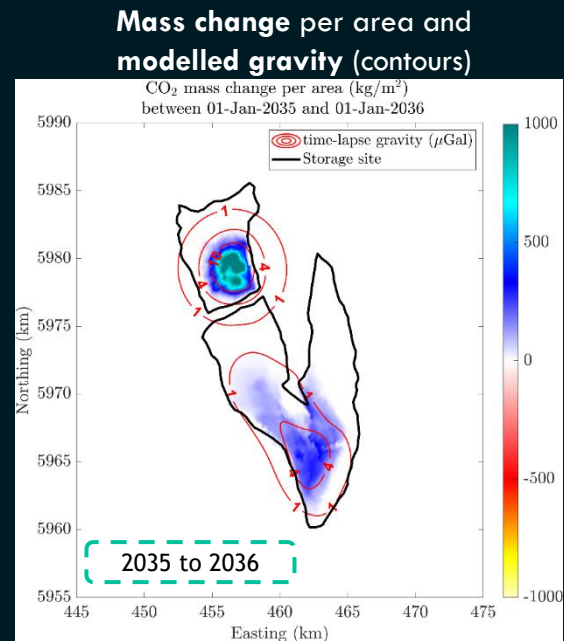
Challenges

- Windfarms (active and planned)
- Water depth (20-30m)
- Simops

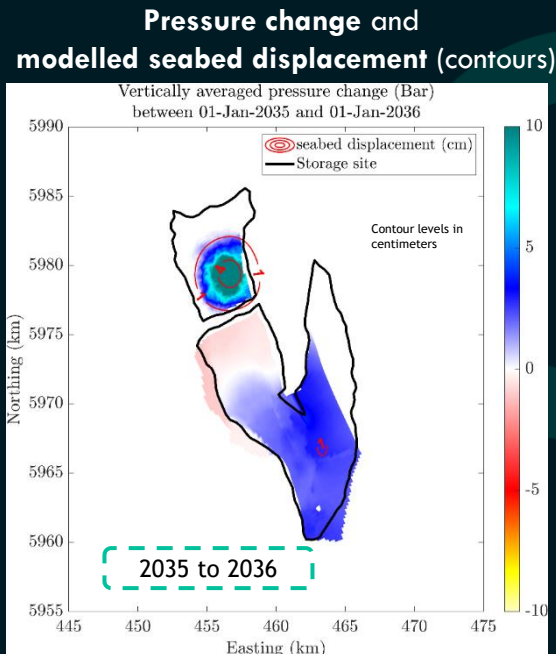


Gravity and Seabed Displacement

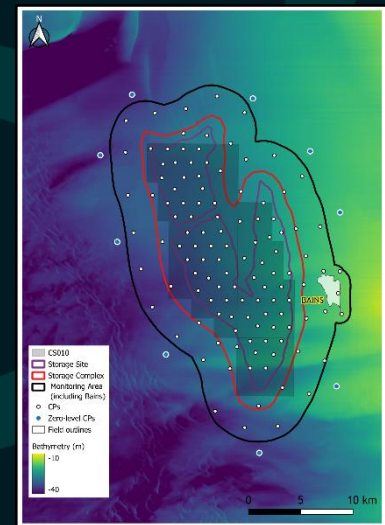
Example 4D gravity
survey design evaluated



Time-lapse accuracy of around 1 microgal

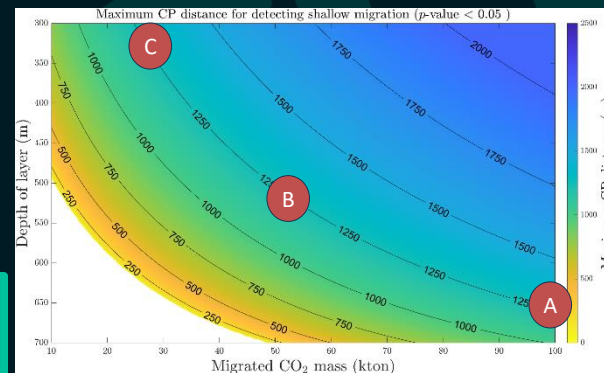


Time-lapse accuracy of around 2-3 mm

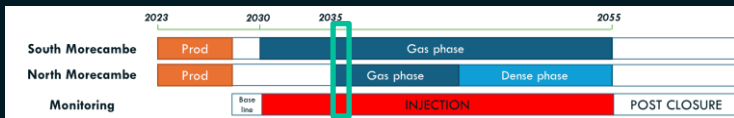


Modelling shows detection of secondary containment in the storage site achievable: suitable **containment** monitoring tool

CP separation required to detect different secondary containment masses of CO₂ at different depths



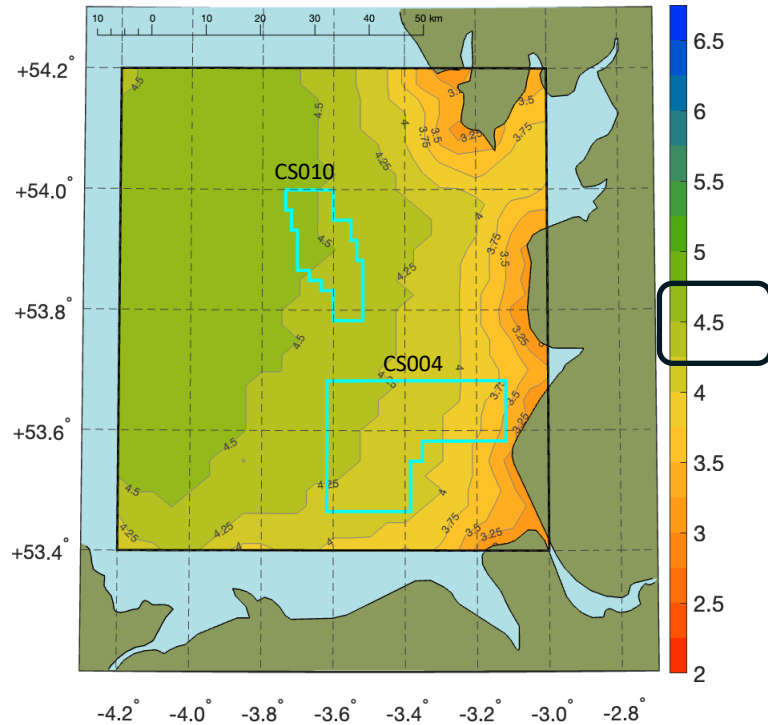
CO₂ plume movement through operational and post-closure periods detectable: suitable **conformance** monitoring tool



Seismicity Monitoring

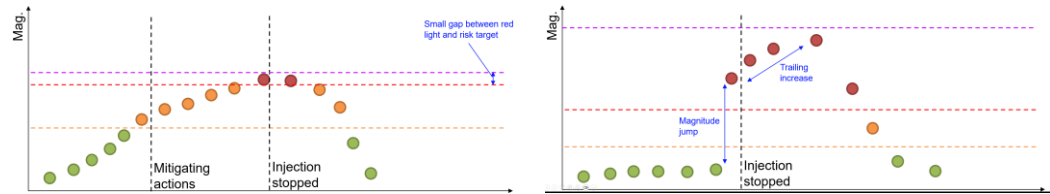
Will a set of onshore seismometers provide sufficient coverage for MNZ storage sites in CS010?

M_{TOL} (damage) map for East Irish Sea



M_{TOL} for licence area CS010 is

- M 4.5 for damage
- M 3.5 for nuisance



To effectively manage induced seismicity, we need to be able to robustly detect events with magnitudes at least 2 units below M_{TOL}

BGS national network detection in the EIS is between 1.5 to 2.0.

Some improvement in monitoring capability is therefore recommended.

What are we seeking from technology suppliers ?

Technologies we can clearly and fully justify

- Effective for a pressure depleted reservoir
- Clear understanding of technology readiness level (TRL) for CCS
- Clear understanding of detectable levels for 'system parameters' in a risk assessment
- Sufficient detail to enable assessment in
 - 1) Monitoring & corrective measures objectives
 - 2) Regulatory reporting

