CARBON STORAGE MMV TECHNOLOGY SHOWCASE, EAGE 2026

Morecambe Monitoring Requirements and Technology Selection

Helen Basford (Spirit Energy)

June 2026

Outline

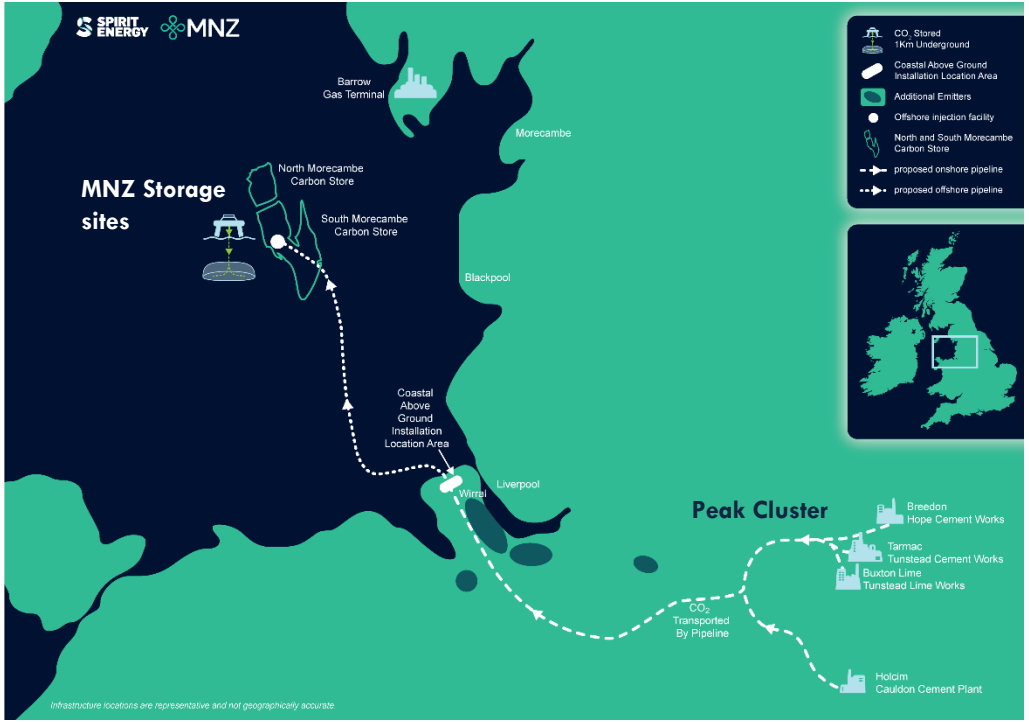
- Project and storage site overview
- Approach to monitoring plan development and screening
- Morecambe monitoring plan concept
- From screening and concept to technology selections;
  - The science, the technology readiness level (TRL) and the practical elements

The MNZ Project & Timeline

- **2023**: CS010 Licence Award
- **2024**: Completed studies on **Early Risk Assessment, 3DHR Seismic Acquisition,** CO_2 Injectivity, **4D Seabed Gravity, Passive Seismic Monitoring;** interim 3D Seismic Processing results
- **2025**: Final 3D Seismic Processing, Site Characterisation Review, project pre-FEED studies, **Monitoring plan concept, Corrective measures concept**
- **2026**: CS010 enters Assess Phase, development concept selection

---

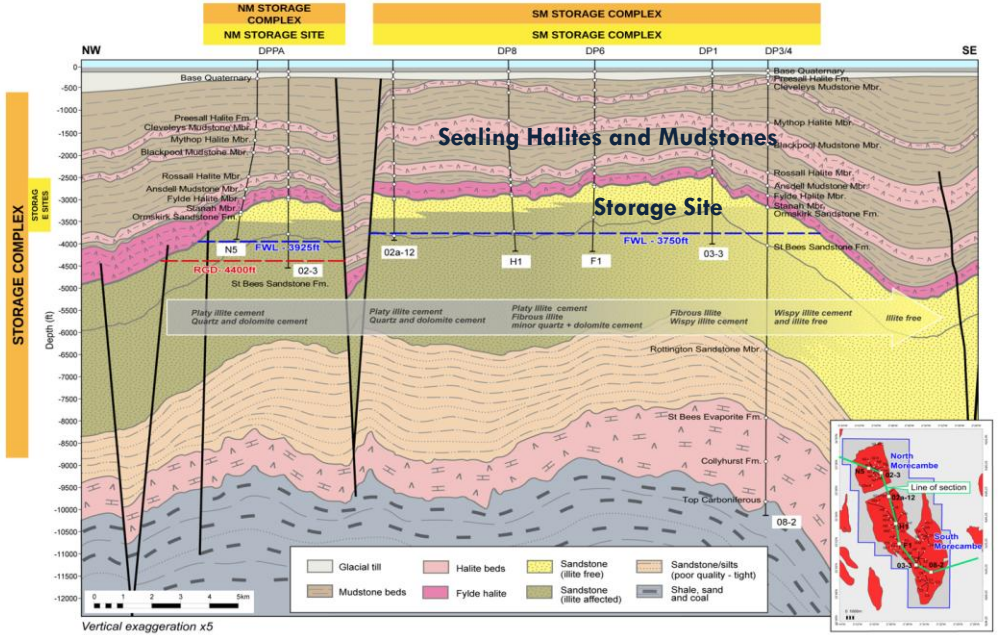
- **2027**: Project FEED studies, Final Site Characterisation, Preliminary **Containment Risk Assessment & Monitoring / Corrective Measures Plans,** Field Development Plan
- **2031/32**: First injection of CO_2 from Peak Cluster emitters

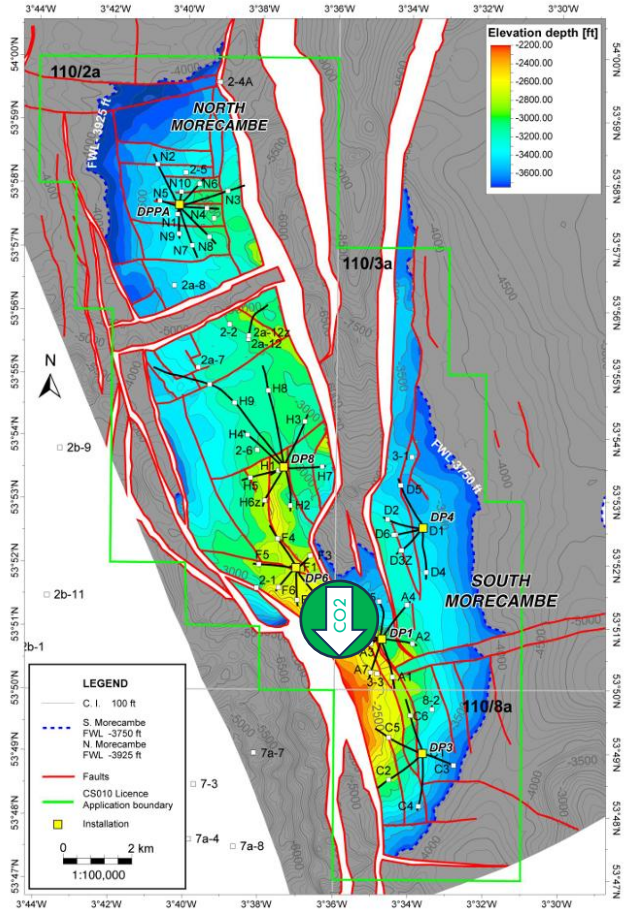


- Morecambe Net Zero (MNZ) collaboration with Peak Cluster to decarbonize 40% of UK's cement production
- Peak Cluster secured £28.6M investment in 2025 for FEED studies and now progressing through consenting for a 200km onshore pipeline gathering system

MNZ

MNZ Storage Site Summary



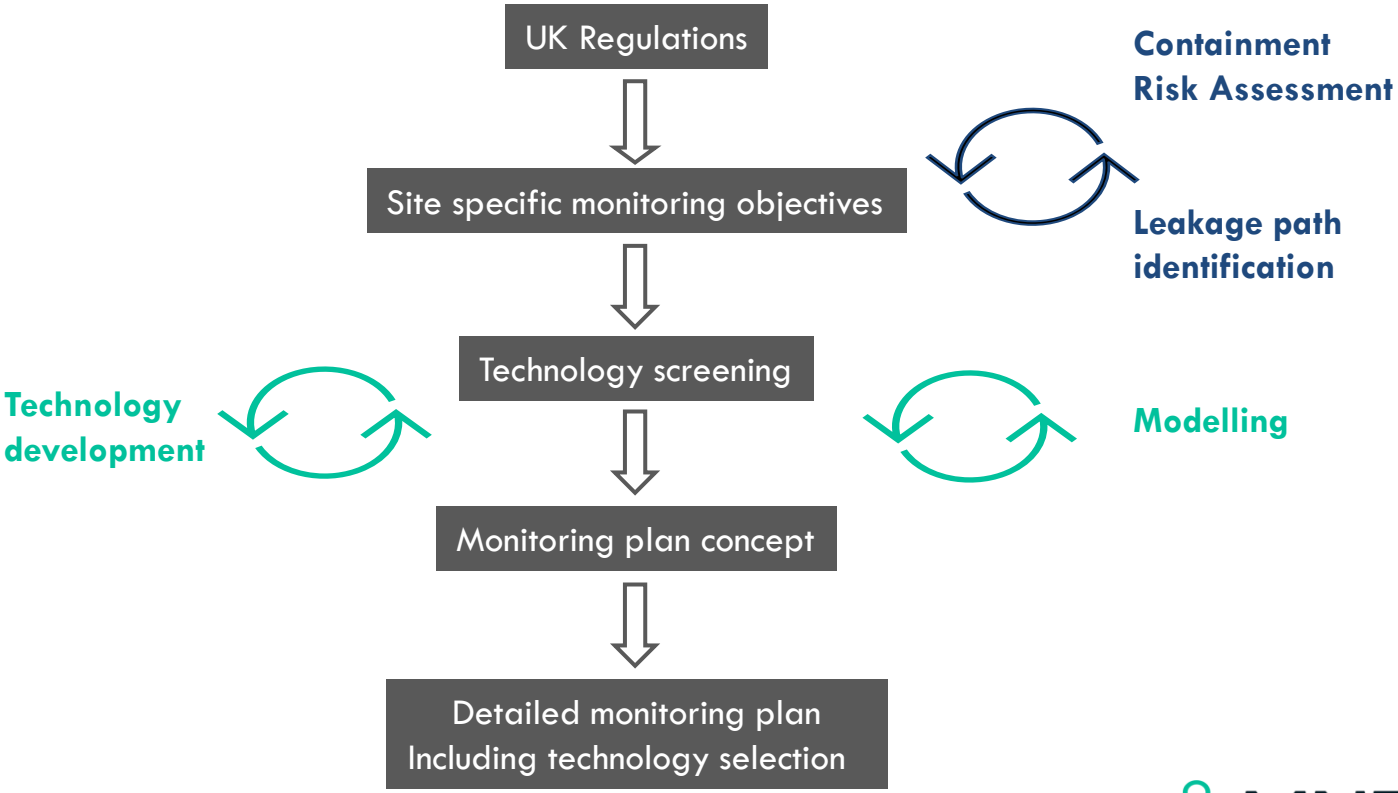


- Ultra-depleted offshore gas field
  - still in production
- Shallow storage site
  - crest 2200ft / 670m
  - free-water level 3750ft / 1143m

- 58 E&A/producer wells in storage sites
- Initial phase of project:
  - South Morecambe with a single CO_2 injection platform (multiple wells)
  - Initial gas phase injection

Monitoring Plan Development

- Top-down approach, starting with clear definition of what the MP needs to achieve.
- Closely linked to the risk assessment process.
  - Bow-ties, Italian flag, decision trees, risk matrices
- Iterative, evolving as the project evolves.



Technology Screening

Confidence in technology in assisting with risk mitigation based on assessment of:

- Accuracy, precision, resolution, detection limits, measurement uncertainty, repeatability

MONITORING OBJECTIVES

RISKS at Early Risk Assessment (ERA)

USES

- Identify strengths/weaknesses
- Screen out technologies not applicable or suitable for MNZ monitoring
- Identify watchlist technologies (currently low confidence/low TRL but could be an important solution for MNZ monitoring)

Colour represents score.
Green = High
Red = Low

From Screening and Concept to Technology Selection

The Science

- Licence specific forward modelling
- International analogues

Good understanding for MNZ

Technology Readiness Level

- Industry suppliers
- Research consortiums
- Early carbon storage projects

Rapid progress being made

Practical Elements

- Offshore injection wells
- Other seabed users
- Licence area
  - Seabed conditions
  - Water depth
  - Distance from shore
  - Power availability

CS010 licence specific conditions

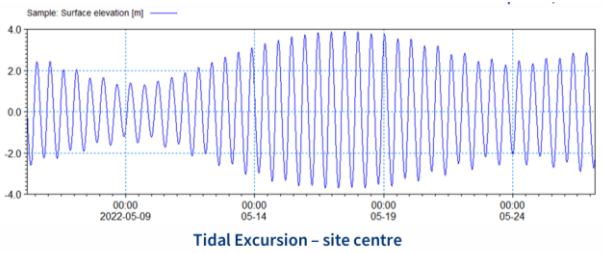
Status

MNZ

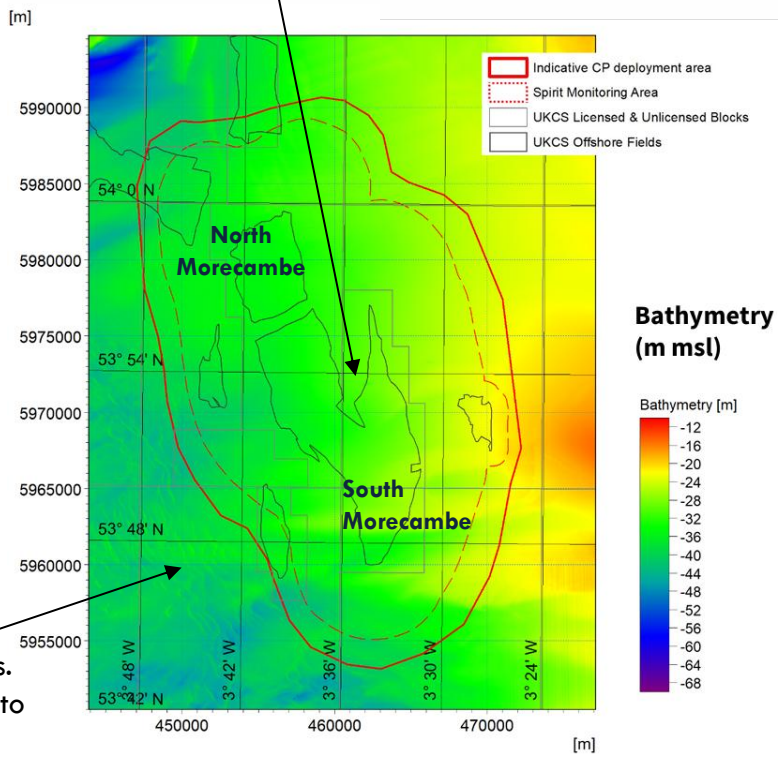
CS010 Licence Specific Conditions

MNZ Seabed Conditions

- Water depths across monitoring area: 20-50m
- Large tidal range and large variation between spring and neep tides
- Shallow sediments: fine sand in the deeper regions to the west to muddy sand and silt in the eastern shallower areas



Largely featureless across storage sites

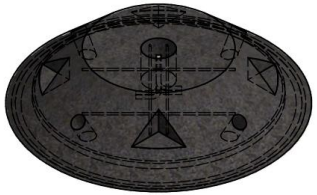


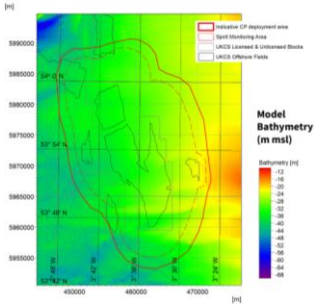
TETRA TECH
RPS ENERGY

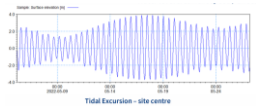
Sand waves and mega-ripples. Migration eastwards too slow to impact CS010 monitoring

MNZ

Gravity: Practicalities







The Requirement

- Requires a concrete pad to be placed on the seabed for the duration of monitoring period
- In order to achieve the accuracy that the technique can deliver, concrete pads need to remain stable so that movement can be attributed to seabed displacement

The Challenge

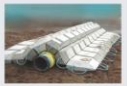
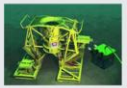
- CS010 is located in shallow waters, with high tidal range and soft seabed sediments

The Approach

- Collaborative approach with geotechnical (TTRPSE) and seabed gravity acquisition (Reach Subsea) consultants

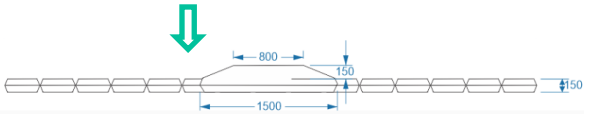
The Solution

- Articulated mattress required to prevent scour
- Single design suitable site wide
- Settlement durations (for 90% settlement) vary across the site: controlled by shallow clay distribution

Existing Design	Mattress	Driven Pile	Suction Pile	Torpedo Pile
Quick and easy to install Sensitive to fishing and scour	Quick and easy to install Limited sensitivity to fishing	Complex installation Very reliable datum Snag risk to fishing	Complex installation, Soft clay only Reliable datum Snag risk to fishing	Simple installation, Soft clay only Uncertain depth of penetration
				
Not considered optimum for MNZ.	Considered to be the most suitable solution for MNZ across the site.	Not considered to be suitable for MNZ due to cost of installation.	Option was not considered suitable for MNZ.	Option was not considered suitable for MNZ.

TETRA TECH
RPS ENERGY

Assessment for
- Settlement
- Scour
- trawlability



MNZ

Seismicity: Practicalities

The Requirement

- Offshore seismicity detection system (50km from shore)

The Challenge: (a shared, industry wide challenge?)

- **Data quality, quantity, data handling** and **sampling**
- Location and **power options** for seabed nodes
- TRL of downhole DAS for seismicity in offshore injection wells
- TRL of surfaces DAS for seismicity
- TRL of acquisition to **assessment workflows**

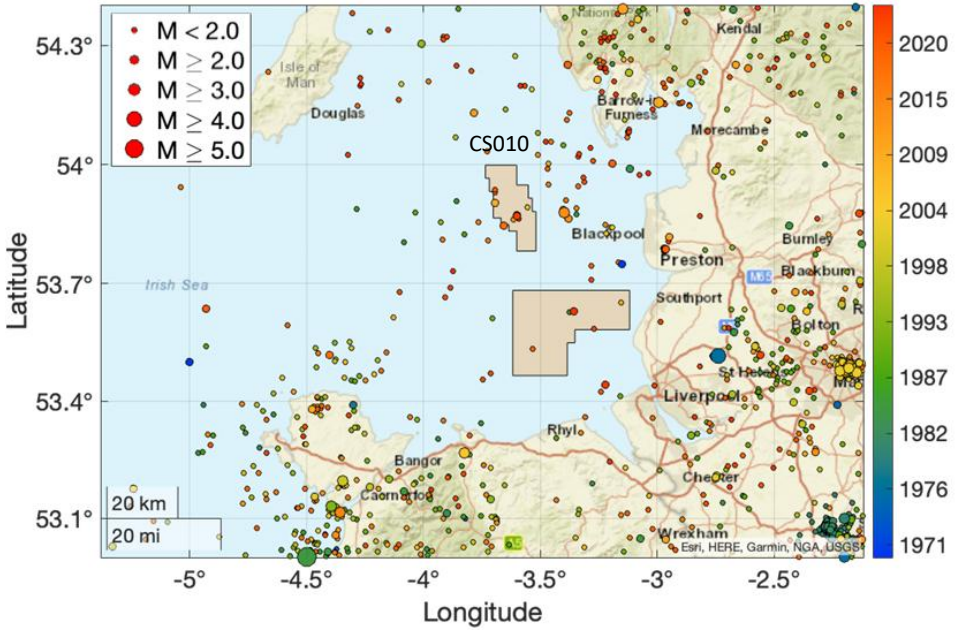
The Approach

- Engagement with JIP's and industry experts
  - BOPS
  - ComPass

The Solution

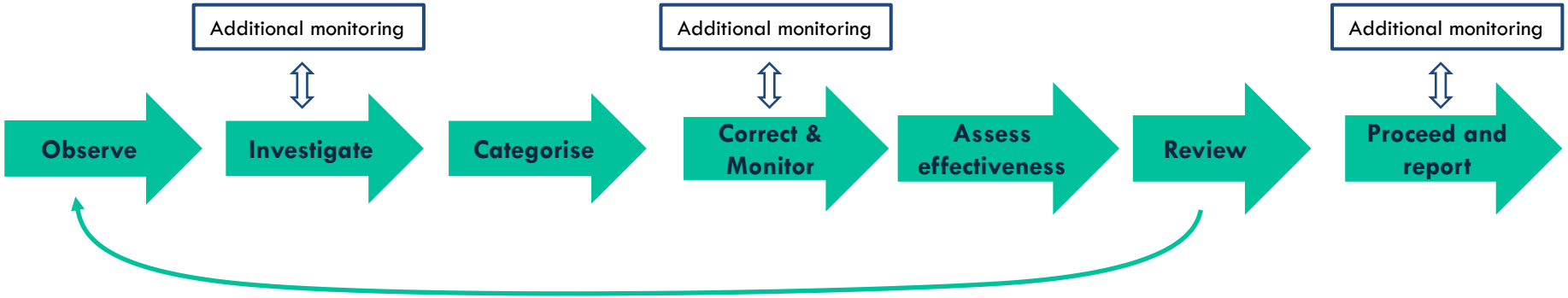
- Evolving
- Working towards UK and East Irish Sea aligned solutions

Historic EIS seismic events (BGS)



Corrective Measures

- High likelihood that corrective measures will include increase in monitoring
  - Investigation
  - Assessment of corrective measures
  - Update to long term monitoring plan



Simplified Corrective Measures workflow

- More technologies for consideration as part of corrective measures toolkit than in monitoring plan

- Time-lapse seismic becomes a corrective measures tool for Morecambe

Summary/Conclusions

- Developing a monitoring plan is an iterative process
- Early feasibility studies have aided in determining what approaches we need to take and has fed into our screening workflow
- Early screening in and out of relevant technologies has enabled us to prioritise where to focus efforts in refinement
- Keeping a live screening tool will enable Spirit to revisit technologies as TRL's increase
- We know what data types we will need to acquire to monitor MNZ, the next steps for us are to understand how we do that
  - technologies/tools:
  - spatial/temporal frequency

- We need the right balance of what is required and what is achievable

MNZ

THANK YOU

Morecambe Monitoring Requirements and Technology Selection

June 2026