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The competition for offshore real estate: Windfarms and hybrid uses

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6th International Workshop on Offshore Geologic CO₂ Storage

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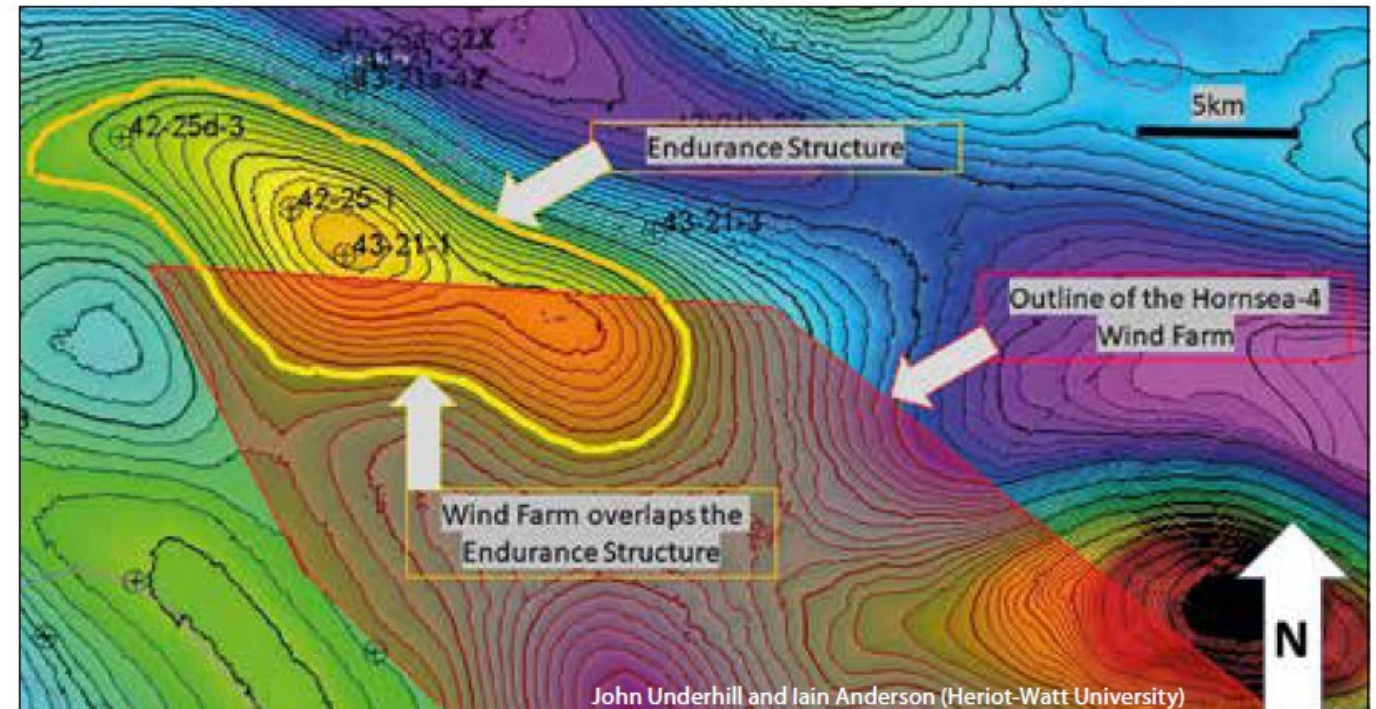
University of Aberdeen, Scotland

Wednesday 13th – Thursday 14th September 2023

Co-Location Issues...

- **Best (worst?) exemplar?**
- **BP-led JV: Endurance: Track 1 carbon store;**
- **Orsted operated Hornsea wind farm, the largest offshore fixed installation in Europe;**
- **Although now resolved, the issue has not gone away and affects many areas;**

A top structure map of the Triassic Bunter Sandstone Formation (in TWTT) showing the location of the Endurance closure that is the foundation of the recently awarded East Coast Cluster carbon store and the Hornsea-4 wind farm. The overlap between the structure and the wind farm makes measuring, monitoring and verification of carbon dioxide injected into Endurance all the more difficult and costly. The map underlines the need for regulators, wind farm operators and those pursuing carbon storage to be more aligned to avoid unintended consequences resulting from a competition for the seabed and subsurface that lies immediately beneath.



Why is this Conflict Important?

- Impacts whether and how to Measurement, Monitoring and Verify (MMV) carbon stores;
- Risk, Insurance and Indemnity;
- What has primacy?
- Could it effect the UK's ability to meet Net Zero targets?

The Need for Joined-up Thinking to Optimise Use Of the North Sea to Achieve Net Zero Targets

In the run-up to the COP26 climate summit, John Underhill, Professor of Geoscience & Energy Transition at Heriot-Watt University, highlights the Importance of an Integrated approach to energy transition.

JOHN UNDERHILL

The UK has been highly effective in decarbonising the UK electricity system through the use of renewables in general and wind power in particular. The contribution made by wind power has risen four-fold in a decade – from 5.4 GW in 2010 to 24 GW in 2019 – and it contributed 24.8% of UK electricity supplied in 2020, having surpassed coal in 2016 and nuclear in 2018. Although initially dominated by onshore sources, the contribution made by offshore wind installations has rapidly caught up to be roughly equal now and will provide most of the electricity in the future.

The appetite for offshore wind remains high and there have been demands for more wind farm licences to be awarded. The next round (Phase 4) of awards promises to be the largest yet with substantive areas of the continental shelf becoming hubs for wind energy. It is also providing a tidy green-energy windfall income stream.

Despite the undoubted positive contribution that wind has made to

decarbonise the electricity system, there are unintended consequences that impact our ambition to decarbonise other sectors. In particular, since most wind farms are fixed to the seabed, it is much harder to visualise, characterise, monitor and hence, utilise the subsurface below them, something that is required if we are to locate and evaluate safe storage sites and monitor the carbon dioxide injection needed to decarbonise the UK's industrial hubs.

Subsurface imaging is primarily through the acquisition of seismic reflection data that produces an accurate 3D 'body scan' of the buried geology. The data is usually obtained by towing a long streamer of sound wave receivers. Unfortunately, wind farm installations preclude this method since it's akin to the boat and its recorders having to navigate a large 'ski slalom'.

The competition for offshore seabed and subsurface 'real estate' has come into sharp focus with the publication

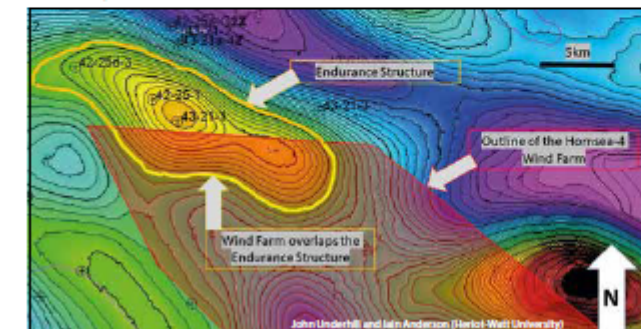
of the Net Zero Strategy and the green light for two carbon storage licences. One of the prime sites (Endurance) that underpins the East Coast Cluster carbon store will be covered by the Hornsea-4 wind farm. As a result, it may prove necessary to use sea-bottom sound recorders, something that could add an order of magnitude of cost to the project (from £5 million to £50 million) meaning it and other projects may no longer be viable.

Wind farms are undoubtedly a valuable technology for the energy transition and a crucial part of our efforts to decarbonise. However, holistic, joined-up thinking is needed to ensure the best and most appropriate use is made of the seabed and subsurface geology. A collective failure to understand the dependencies and the impacts that their blanket coverage has may rule out other promising technologies and hold back the UK's pathway to net zero.

The occurrence of wind farms and significant monitoring issues will affect our ability to build a blue hydrogen capacity because of the spatial association needed between a producing gas field, carbon store and hydrogen export route to shore (and storage), any one of which might be precluded by the competition for space.

Judicious management of the offshore areas is urgently required that involves collaboration between the regulatory bodies (Crown Estate and the Oil & Gas Authority) and the various wind farm, gas and carbon storage operators to avoid unhelpful competition. Only by doing so will the UK have choices for the low-carbon technologies and re-purposing of the North Sea for the low-carbon energy transition. It is essential to get the optimal use of our offshore subsurface resources if we have any chance of achieving our net zero targets. ■

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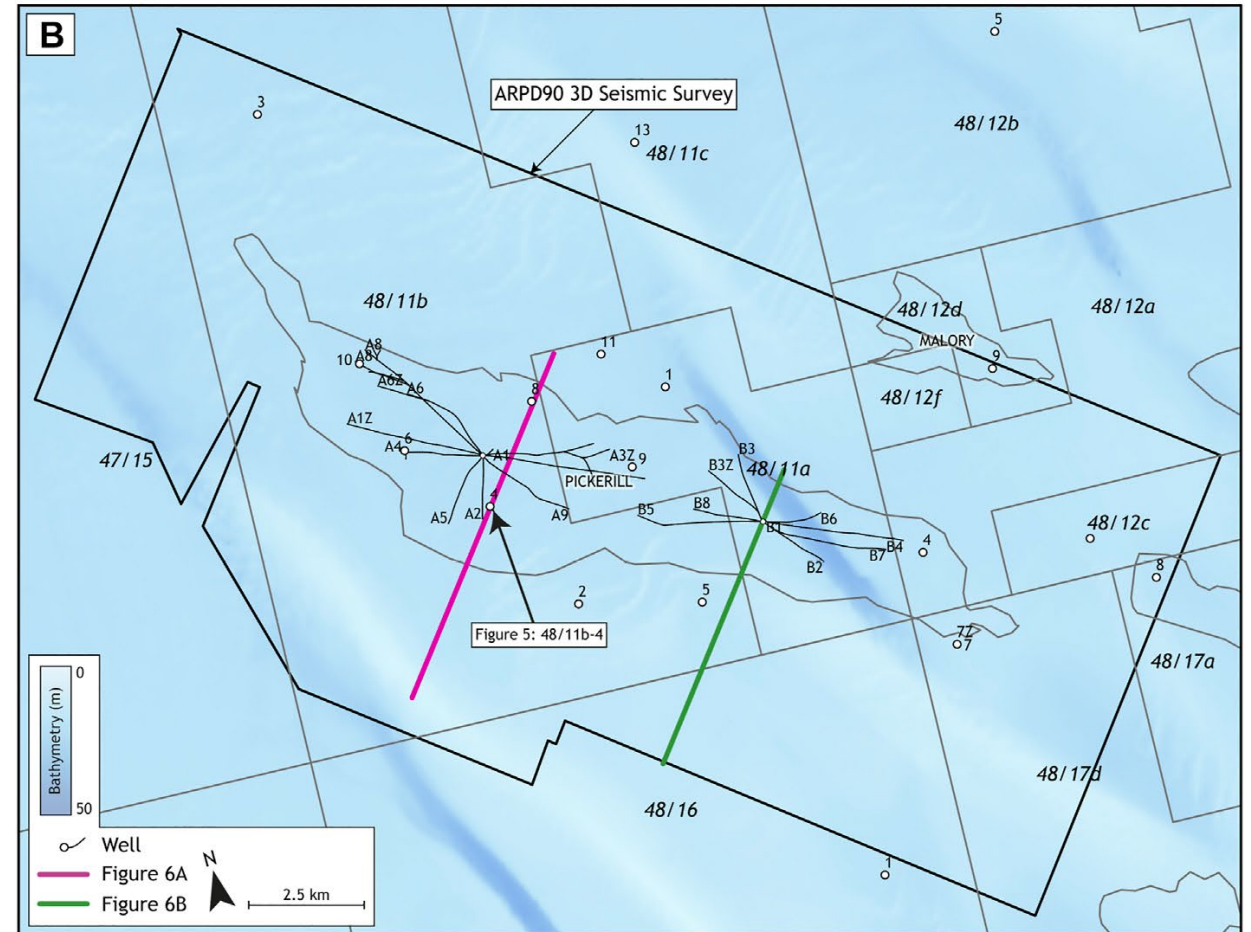
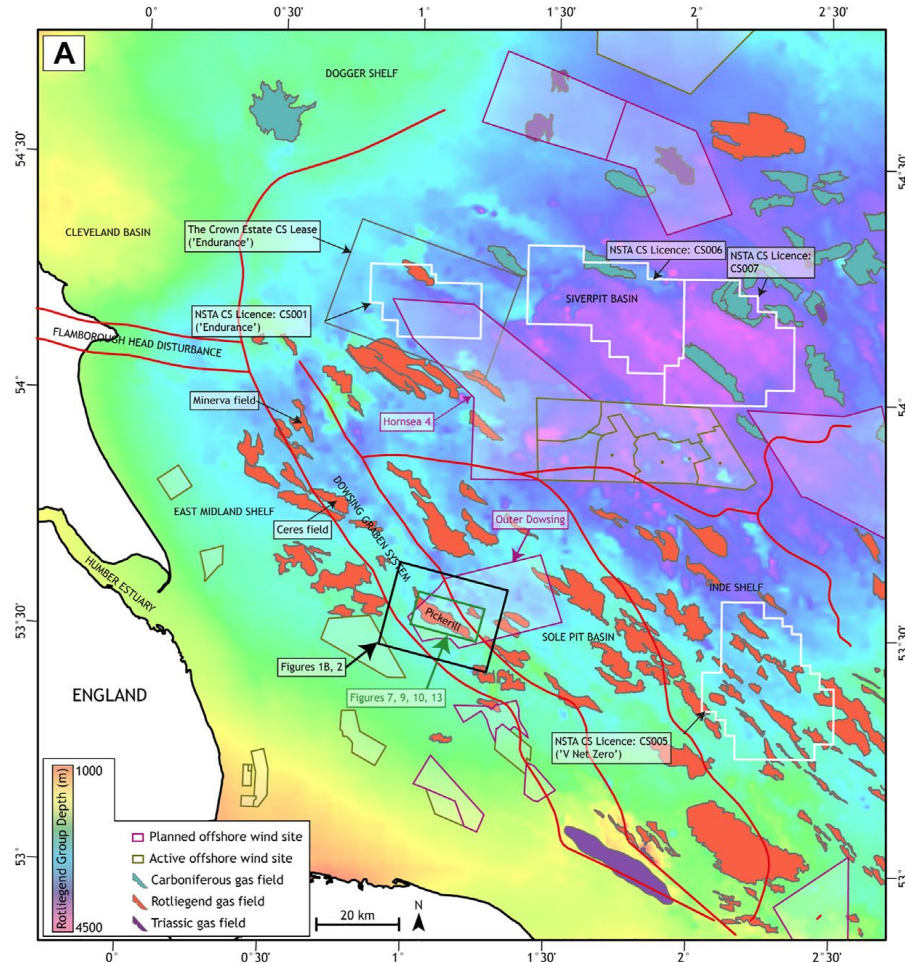


Use of Subsurface Geology in Assessing the Optimal Co-Location of CO₂ Storage and Wind Energy Sites

I. de Jonge-Anderson^{1*} and J. R. Underhill²

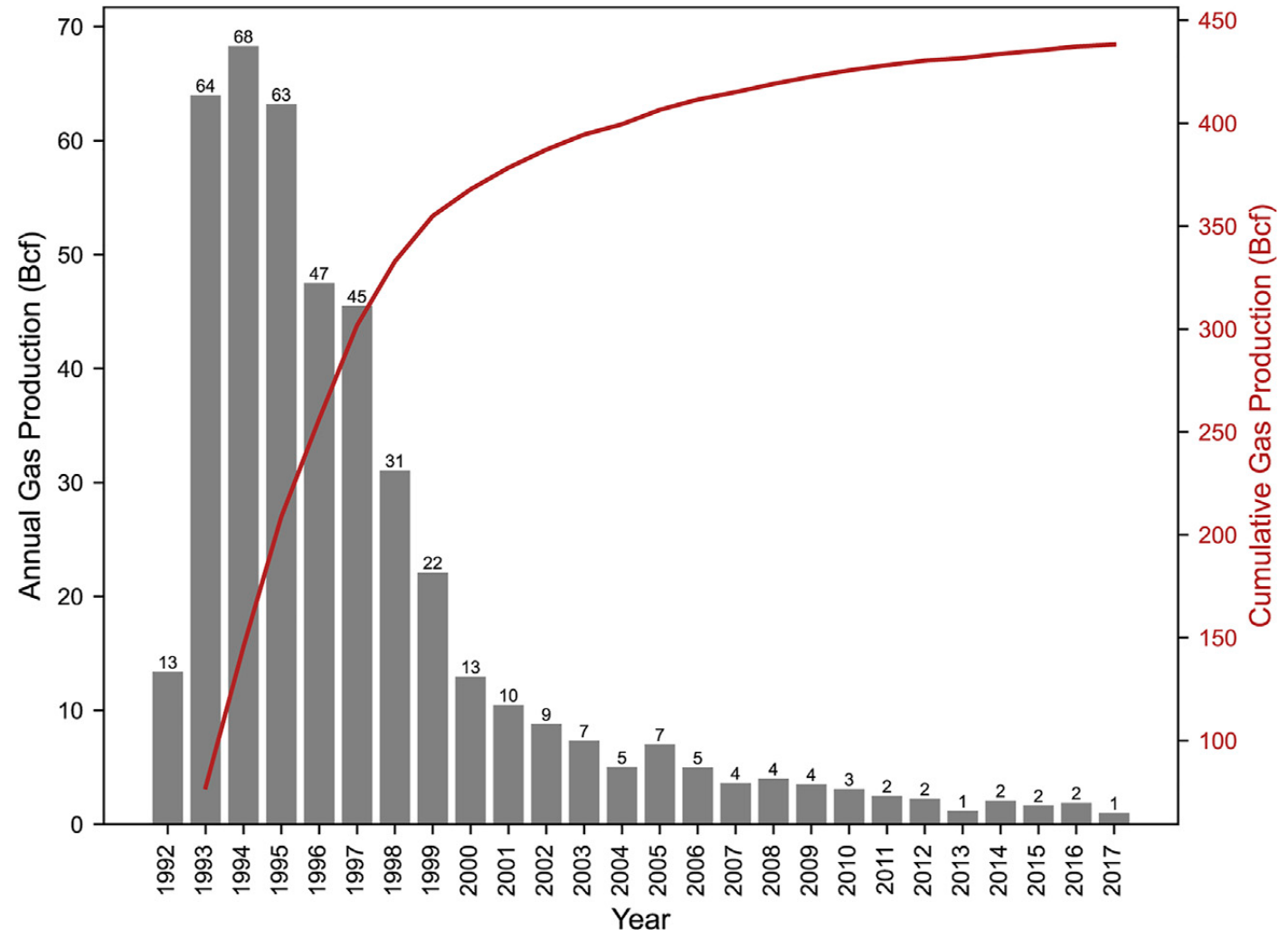
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Location of the Pickerill Field

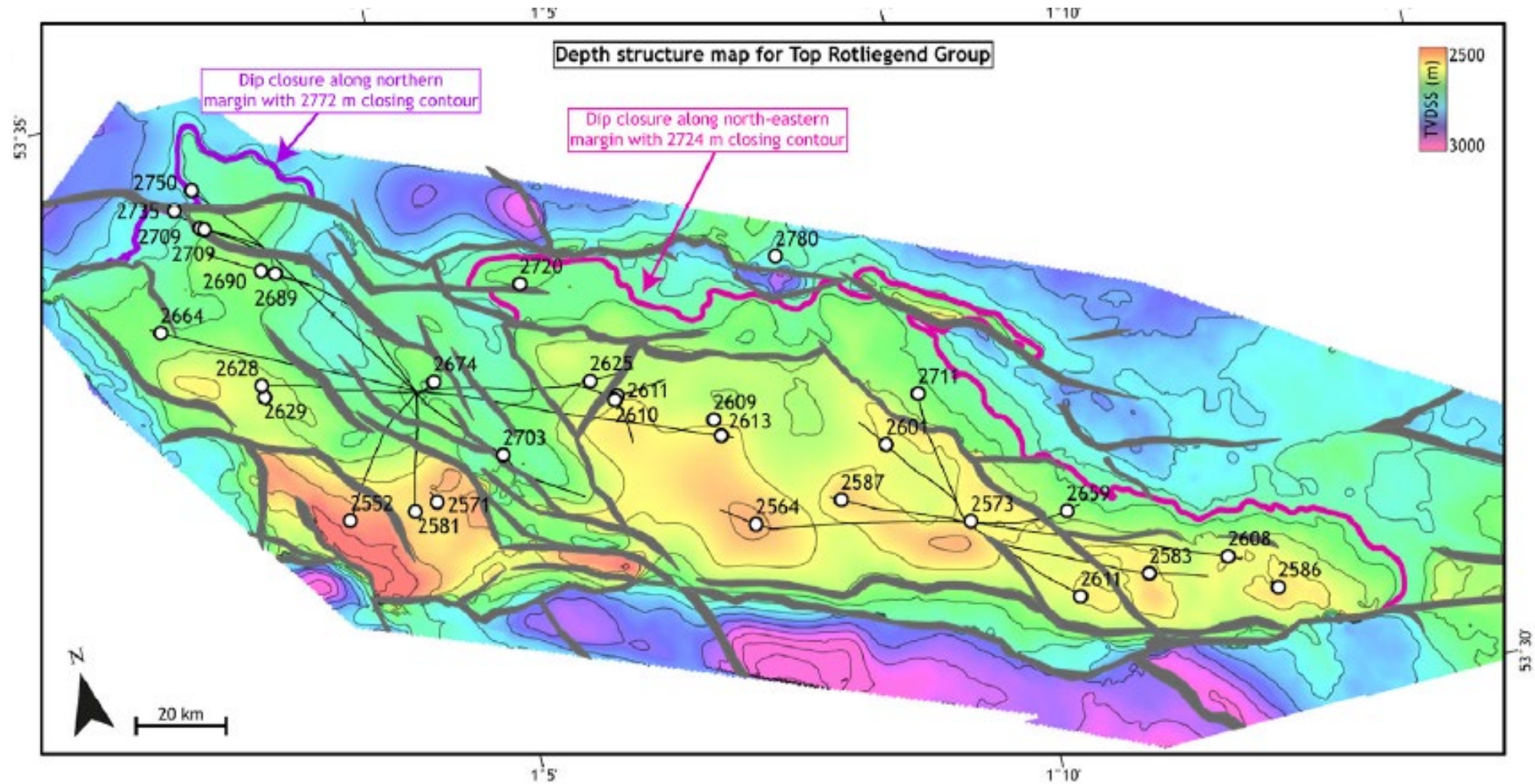


Pickerill: Capacity

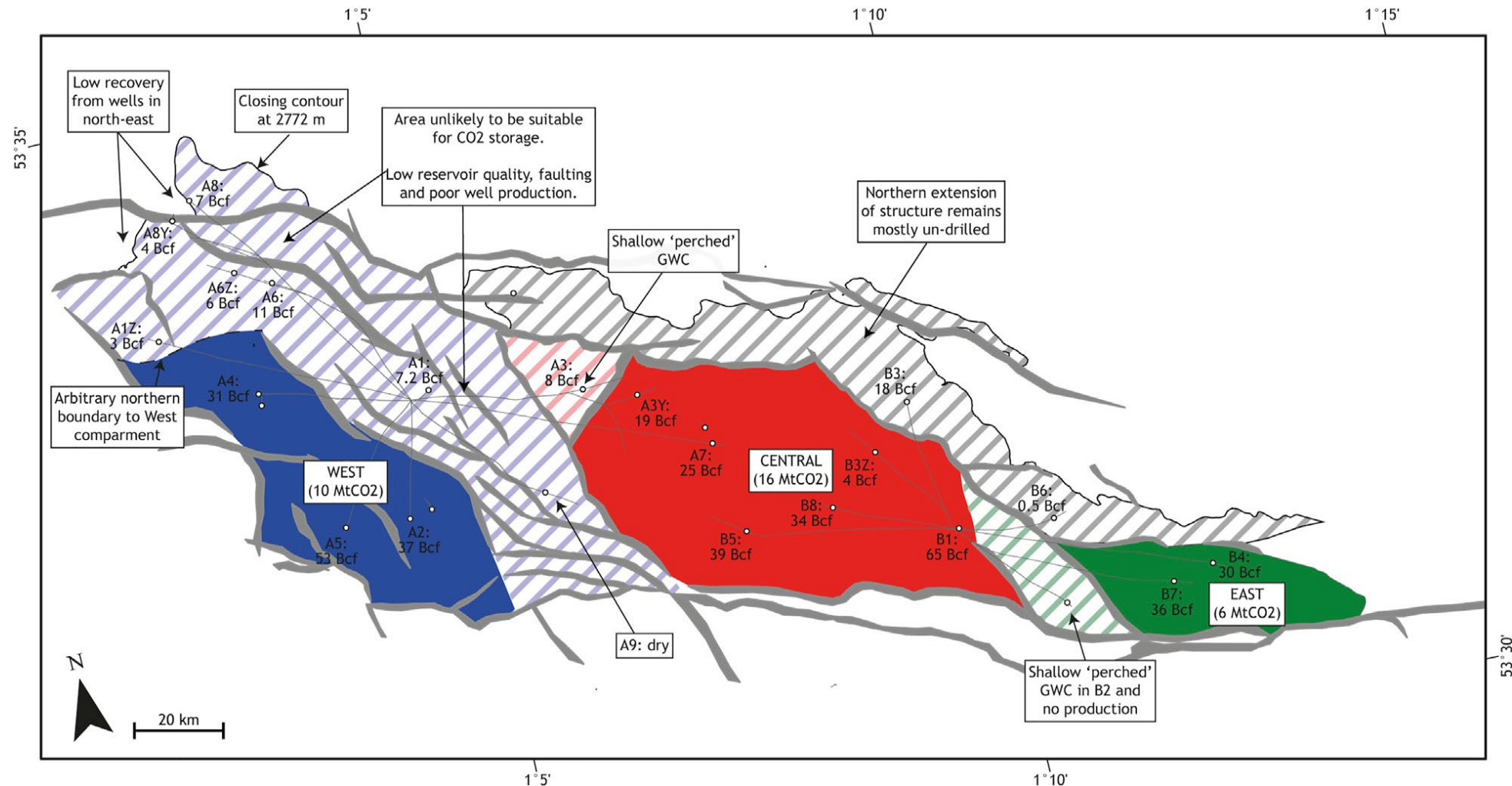
- Rotliegend Field (sub-salt)
- Annual (grey bars) and cumulative (red line) gas production from the Pickerill field.
- Around 440 Bcf was produced from the Pickerill field in total. Production data accessed from NSTA



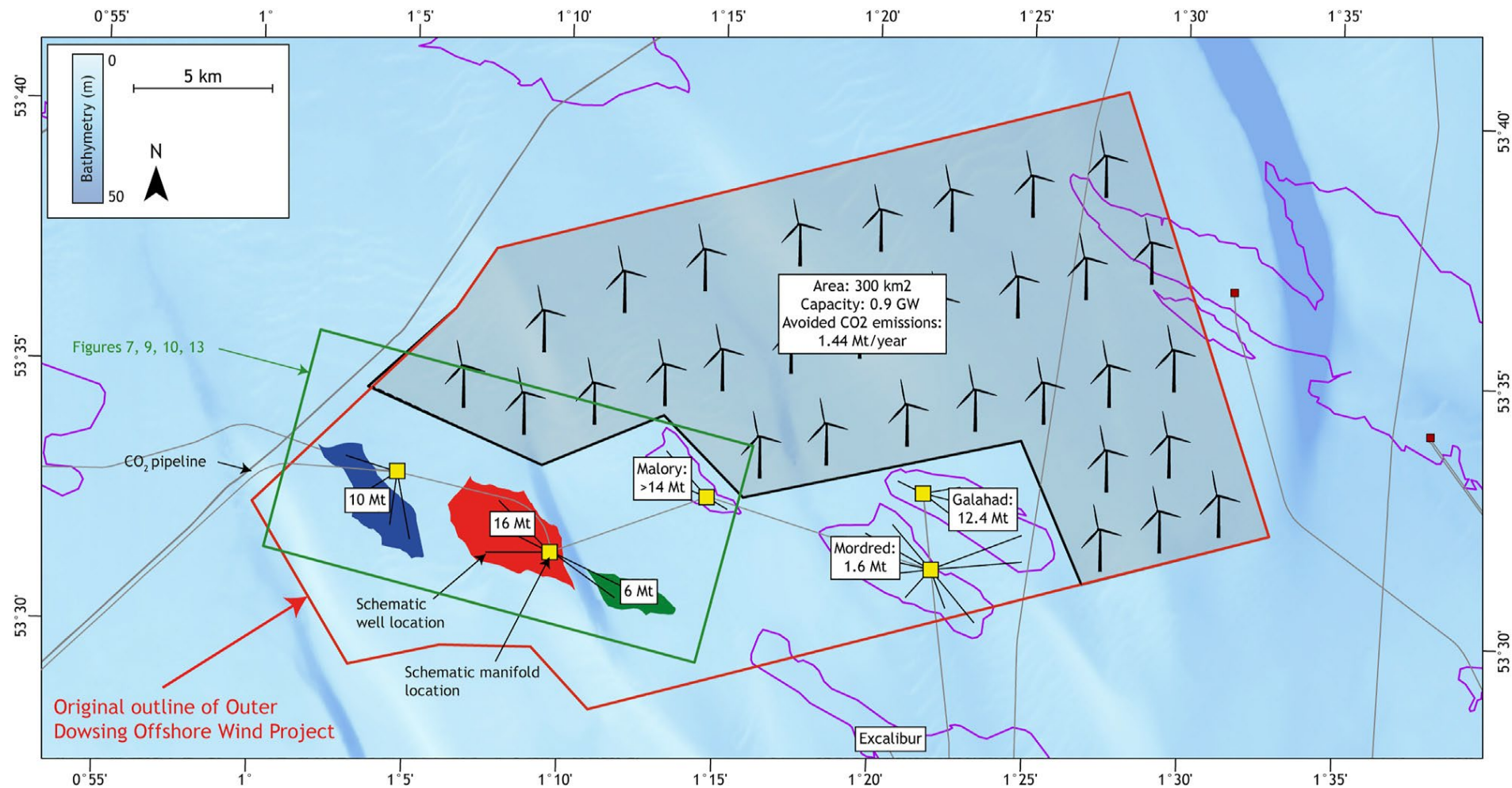
Top Structure Map



>32mT of carbon dioxide storage



Can an equitable solution be found?

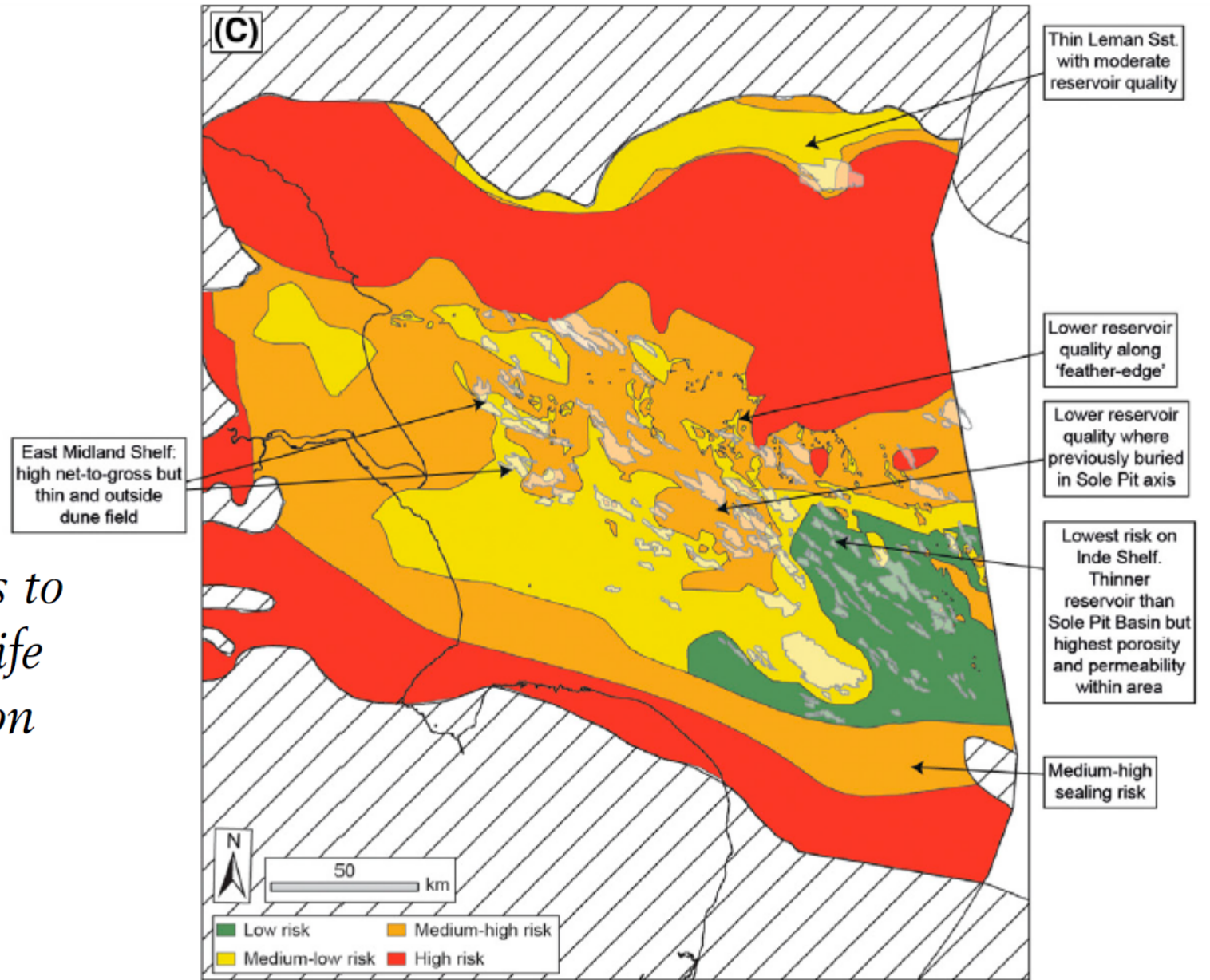


CS screening

- **Composite Common Risk Segment (CRS) Mapping**

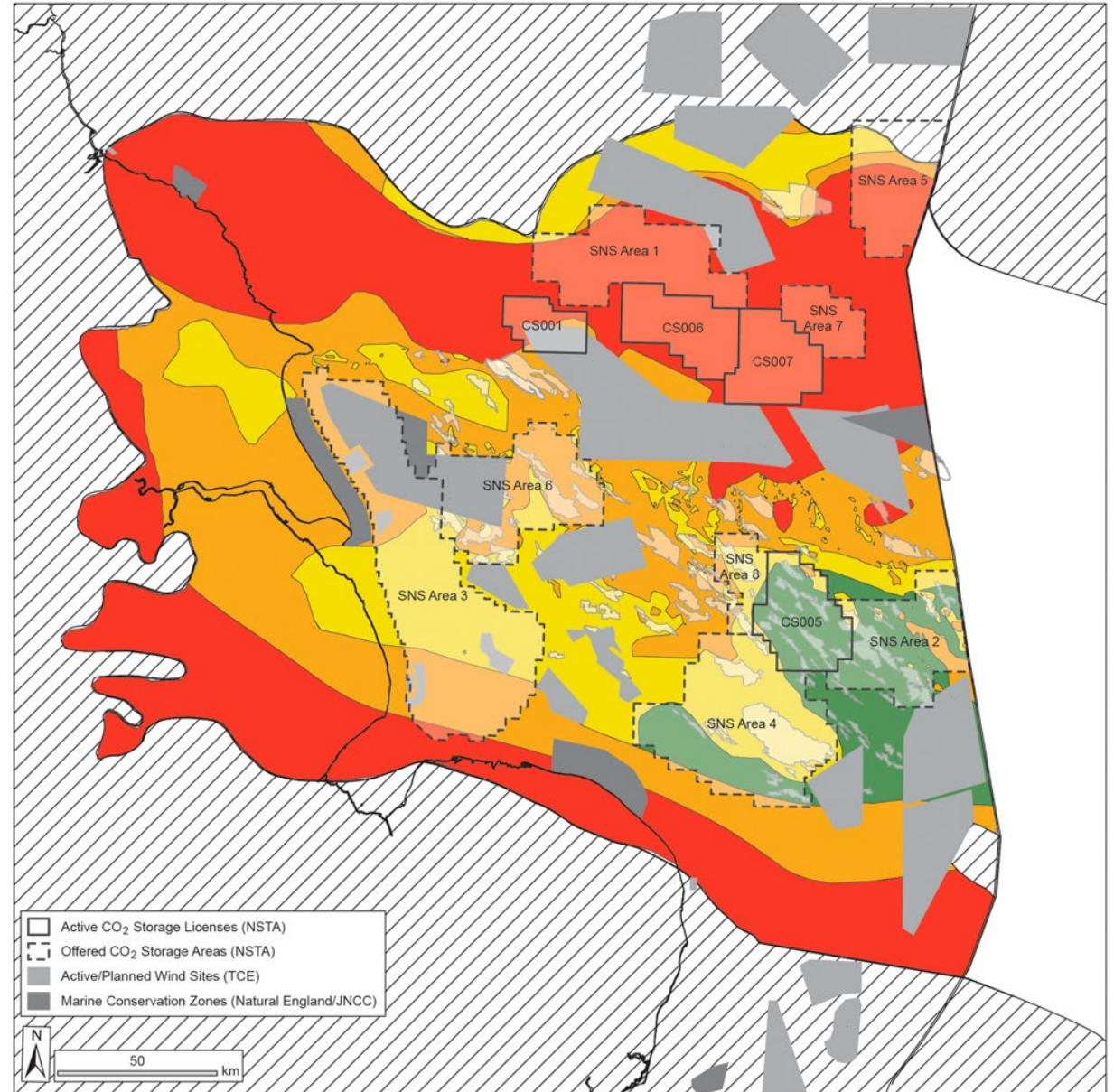
Use of exploration methods to repurpose and extend the life of a super basin as a carbon storage hub for the energy transition

**J. R. Underhill, I. de Jonge-Anderson,
A. D. Hollinsworth, and L. C. Fyfe**



Overlay of Windfarms

- Location of wind farm leases;
- Carbon Storage licensing round avoided the conflicts;
- Other stakeholders in the mix too;



Conclusions

- **It's getting mighty crowded!**
- **Can we find a way for wind farms and carbon stores to co-locate (e.g. through novel MMV strategies)?**
- **But there are lots of other stakeholders and regulators in the mix too...**
- **What has primacy when there is overlap?**
- **Is there a need for an overarching Net Zero Regulatory Body to referee and adjudicate when conflicts arise to ensure UK Net Zero plc makes the best and most informed choices?**
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