Consultation Response by SCCS on the CCS Directive Guidance

July 2023, Andrew Cavanagh, SCCS Storage Expert & Net Zero Policy

FAO: Dr Jørg Aarnes
DNV, Oslo

Dear Jørg,

Re: Consultation Response by SCCS on the CCS Directive Guidance

Thank you for an interesting day in Brussels on Tuesday 11 July. DNV are clearly doing a great job on the Guidance documents. I reported this back to SCCS on my return to Edinburgh.

On reflection, the feedback from SCCS is that the new Guidance documents 1 and 2 could be improved by further clarifying aspects that relate to the regional scale of CO_2 storage, which will reach unprecedented rates and absolute amounts in the coming decade – see our position paper linked below which examines why delays on storage are likely to result in greatly increased storage rates and, possibly CTBO regulation for mandated storage in both UK and EU to ameliorate the harder task of reductions through social change:

Preprint on EarthArXiv - Mind the Gap: Is CO2 storage undermining Net Zero 2050?

The existing Directive and Guidance reflect the status quo circa 2011, which was very much an ambition for demonstration megatonne projects like Sleipner and Weyburn. The 2030s and 2040s is likely a world of many multi-megatonne projects competing for porespace as total storage amounts approach gigatonnes. As such, we feel that two issues require careful consideration and expansion in the Guidance:

1) Competition and Porespace Management
Firstly, the pressure footprint of large projects needs to be considered, as first examined by Zhou et al (2009) in the Illinois Basin. Closer to home, the BGS have modelled the Bunter Formation (Williams et al, 2013), and in Scotland, the Multistore project (SCCS, 2015) concluded that:

- Storage of CO_2 at more than one injection site will create widespread interacting pressure changes within a storage formation, which will determine the total amount of CO_2 that can be stored. Appraisal of stores must include the assessment of regional changes in pressure over the lifetime of two or more sites.

- The maximum acceptable pressure for all injection sites in a regional storage formation is ultimately defined at the location with the lowest acceptable maximum pressure limit to ensure security of storage throughout the formation. This location may be distant from an injection site.
- The pressure changes generated at one site will interact with another site and affect any nearby hydrocarbon fields within a storage formation. Pressure changes should be monitored at each of the injection sites and at hydrocarbon fields in the vicinity.

- Interaction of pressure changes may be detrimental to a pre-existing site, which the second operator would address during project design. Transmission of pressure changes will usually take multiple years. In the scenario explored in CO_2 MultiStore the delay is five years for sites that are 45km apart.

For many settings, pressure management will extend far beyond the free-phase plume migration boundary of the site and will potentially lead to conflicts of interest with neighbouring storage projects for both CO_2 and hydrogen. How will pressure footprints be monitored and managed? Even in a finite basin such as the Bunter Sandstone, southern North Sea, our simulations show that excess pressure will decay over multiple decades. Hence, this is a transient problem, not a permanent one.

The remedy may require regional pressure modelling and the coordinated planning of regional storage, with staged licensing to maximise the storage potential of the formation. Does the current Guidance go far enough with its very cursory mention of hydraulic units?

2) Ownership and Legal Boundaries
Secondly, the legality and consequences of pressure, dissolved-phase, and free-phase plume migration across national boundaries will need to be considered carefully in a crowded subsurface. Who owns the pressure, CO_2-enriched brines, and migrating free-phase, and what are their obligations if the footprint of their operation crosses a national boundary?

For regional storage at the gigatonne scale, ownership and boundaries become clear issues. However, over-regulation is too easy a trap and would hinder all development. Pressure footprints are not leaks but do require dynamic management. The Competent Authority must be knowledgeable enough to predict the pressure effects and allocate sites accordingly. Does the Guidance go far enough on these essential aspects?

I am sure these issues and others relating to gigatonne storage in increasingly competitive storage space have occurred to you. The need to host both CO_2 storage disposal and hydrogen energy storage will make for an interesting and possibly contested subsurface in the coming decades. The Guidance will be a key resource in avoiding and resolving disputes.

Best, Andrew

Dr Andrew Cavanagh
SCCS Storage Expert and Net Zero Policy

REFERENCES

SCCS. 2015. Optimising CO_2 storage in geological formations; a case study offshore Scotland. CO2 MultiStore project, September 2015, Report, pp 88.

Williams, J. et al. 2013. Pressure constraints on the CO_2 storage capacity of the Bunter Sandstone Formation in the UK Southern North Sea. Petroleum Geoscience, 20, 155-167.

Zhou, Q., Birkholzer, J. T., Leetaru, H. E., Mehnert, E., Lin, Y-F. F., Tsang, C-F et al. 2009. Basin-scale environmental impact of geological carbon sequestration in the Illinois Basin. 4.