Geological considerations for re-using end of life wells for CO_2 storage as an alternative to abandonment

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Afternoon everyone, Ikon and BGS have worked together on the UK case study part of the REX-CO2 international consortium that has the aim of developing a software tool that can assess the suitability of re-using soon to be abandoned wells, as CO2 injectors.

Study is still in progress and this talk is from part of the UKs contribution

The talk is split in to three brief sections to give an overview of the decommissioning issue, the opportunity for well re-use, and the method for evaluating wells

suitability.

Decommissioning UKCS Oil & Gas Wells and Fields

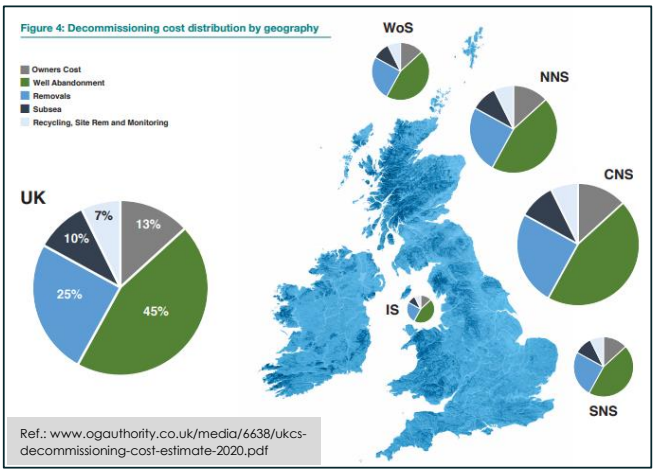
Forecast number of oil & gas wells and fields to be decommissioned on the UKCS from 2019 to 2028

Northern North Sea and West of Shetland	Wells	547
	Fields	41
Central North Sea	Wells	568
	Fields	93
South North Sea and Irish Sea	Wells	515
	Fields	96
	Total Wells	**1211**
	Total Fields	**230**

Ref.: www.statista.com/statistics/749371/forecast-ukcs-oil-well-decommission/

Decommissioning costs per UKCS basin:

- Bulk of costs are related to abandonment



Ref.: www.ogauthority.co.uk/media/6638/ukcs-decommissioning-cost-estimate-2020.pdf

June 8, 2021 2

In coming years and decades decommissioning of oil & gas wells world wide will become an increasingly important issue as fields and basins reach their end of productive life.

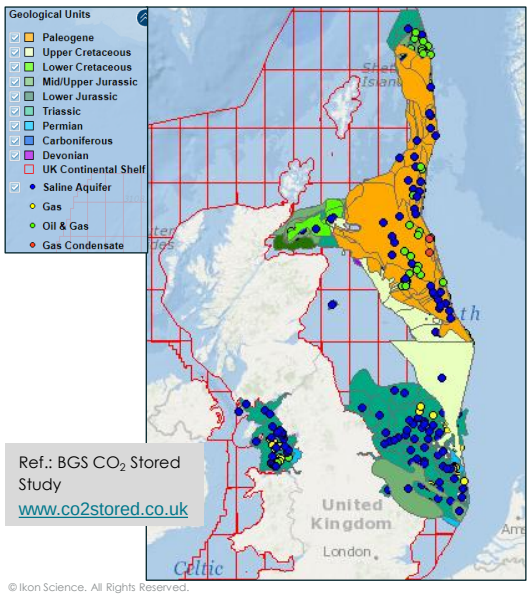
Considering just the UK continental shelf, from 2019 to 2028 there are estimated to be twelve hundred wells across 230 fields that will need decommissioning.

The table on the left shows how those wells are split across the UKCS sub-basins.

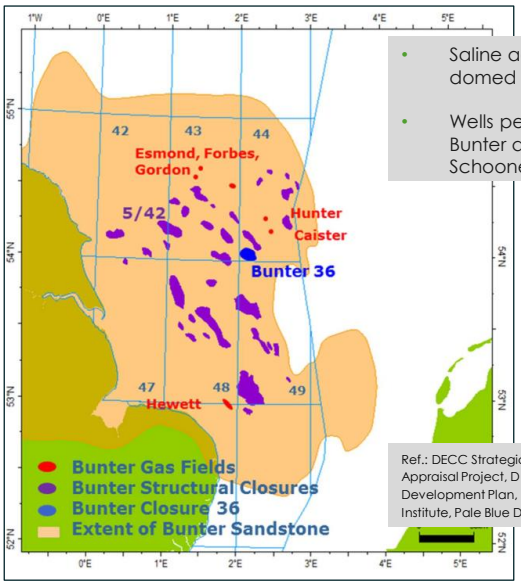
From the figure on the right, the bulk of decommissioning cost is shown to be the well abandonment process. The opportunity that will be

presented is whether these costs can be in part recovered by re-using some of the wells that need decommissioning as co2 injectors, which will also help with the UK's commitment towards Net Zero emissions targets.

Suitable Storage Reservoirs



Ref.: BGS CO_2 Stored Study
www.co2stored.co.uk



- Saline aquifer and domed trap structure.
- Wells penetrating the Bunter are targeting the Schooner Field.

Ref.: DECC Strategic UK CCS Storage Appraisal Project, D10: WP5A, Bunter Storage Development Plan, Energy Technologies Institute, Pale Blue Dot. 2016

June 8, 2021 3

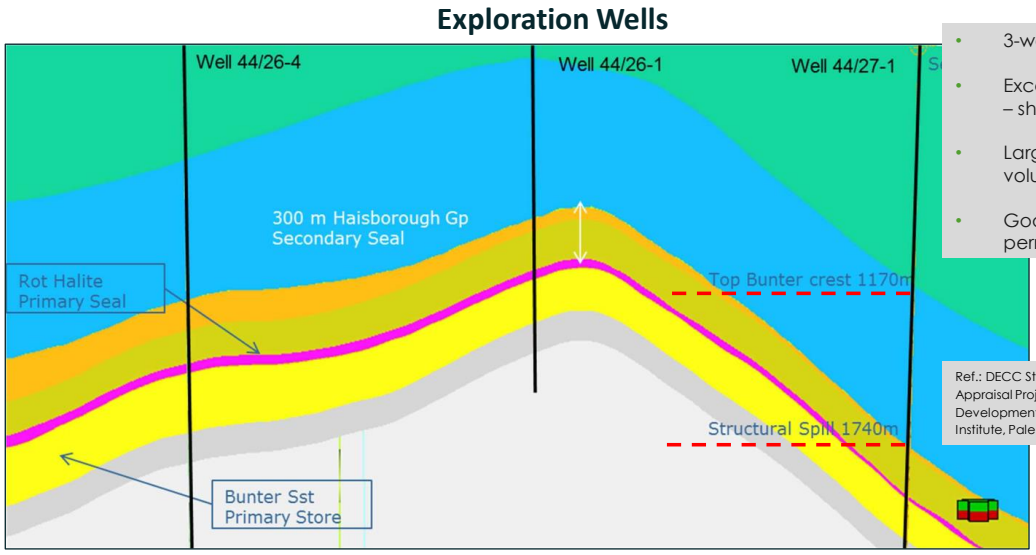
Not all of the 1200 wells and fields will be suitable for CO2 storage, therefore, reference was made to the 2010 BGS study that appraised the CO2 storage volume in UKCS.

The study showed a large number of reservoirs are suitable and they are shown on the map on the left as dots.

To assess the suitability of re-using wells a field that is close to being decommissioned was picked from the BGS co2 stored database

The site selected is the Southern North Sea's Bunter Closure 36 shown on the map on the right

Bunter Closure 36 Case Study



- 3-way dip closure
- Excellent seal properties – shale and halite
- Large accommodation volume
- Good porosity and permeability reservoir

Ref.: DECC Strategic UK CCS Storage Appraisal Project, D10: WP5A, Bunter Storage Development Plan, Energy Technologies Institute, Pale Blue Dot. 2016

June 8, 2021 4

On this slide is shown a cross section through the Bunter reservoir.

The particular features that makes this reservoir suitable for CO2 storage are that it has:

- only very minor faults at top of structure with little offset
- Large margin between reservoir pressure and caprock failure pressure
- reservoir seal is very low or zero poroperm – since it is well compacted Rot shale and also Rot halite
- It also has a 4 way dip closure and high relief to allow high degree of confidence co2 wont leak out and

storage volume can be high

The well shown in the centre is the Closure 36 field's exploration well, which was a dry hole, and two later E&A wells for the deeper Schooner field. All are already abandoned.

Many producer wells have been drilled through the reservoir to the deeper Schooner and these are the ones that have been assessed to determine whether they can be re-used as co2 injectors in to the Bunter.

Bunter Closure 36 Well Penetrations

General well information								
Wellname	KB mt)	Seawater depth (m)	X surface co-ords (m E)	Y surface co-ords (m N)	TD Drillers TVDss (m)	Spud date	Well type	Current Status
43/13a- 5	39.9	-35.0	398441.6	6050160.0	1505.0	23.9.08		AB3
44/26- 1	29.0	-73.5	442727.7	5988812.7	1513.3	30.4.68		AB3
^44/26- 2	27.4	-72.5	437273.2	5993183.0	4087.4	20.6.86		AB3
44/26- 3	26.5	-71.9	442283.1	5989682.6		20.8.87		AB3
44/26- 4	39.3	-70.4	437194.3	5995409.6	4877.7	28.10.88		AB3
44/26a- 7	25.0	-71.3	436309.1	5993426.7	4027.3	6.6.06	PRODUCER	COMPLETED_SHUT_IN
44/26a-A1	42.7	-72.5	439643.5	5990567.4		3.5.95	PRODUCER	COMPLETED_SHUT_IN
44/26a-A2	42.7	-73.2	439949.0	5990563.4		19.8.95	PRODUCER	COMPLETED_SHUT_IN
44/26a-A3	42.7	-73.2	439638.1	5990567.5		19.11.95	PRODUCER	COMPLETED_SHUT_IN
44/26a-A4	42.7	-73.2	439644.6	5990565.3		24.3.96	PRODUCER	COMPLETED_SHUT_IN
44/26a-A5	49.7	-73.2	439641.6	5990570.5		2.10.97	PRODUCER	COMPLETED_SHUT_IN
44/26a-A6	48.2	-72.8	439646.8	5990568.2	3473.2	22.5.98	PRODUCER	AB1
44/26a-A6Y	48.2	-72.8	439646.8	5990568.2	4080.7	28.10.98	PRODUCER	COMPLETED_SHUT_IN
44/26a-A6Z	48.2	-72.8	439646.8	5990568.2	3473.2	25.8.98	PRODUCER	AB1
^44/26a-A7	48.2	-25.0	439646.8	5990568.2	3985.3	22.12.98	PRODUCER	PLUGGED
44/26a-A8	42.7	-70.1	439647.1	5990565.5	4490.6	17.3.00	PRODUCER	AB1
44/26a-A8Z	42.7	-70.1	439647.1	5990565.5		22.6.01	PRODUCER	COMPLETED_SHUT_IN
44/26a-A9	56.4	-72.8	439642.3	5990562.3	2833.7	17.4.03	PRODUCER	AB1
44/26a-A9Z	56.4	-72.8	439642.3	5990562.3	3984.7	23.5.03	PRODUCER	COMPLETED_SHUT_IN
44/26a-A10	53.9	-72.8	439641.8	5990567.7	3782.6	24.11.05	PRODUCER	AB1
44/26a-A10Z	53.9	-72.8	439641.8	5990567.7	3947.2	2.3.06	PRODUCER	COMPLETED_SHUT_IN
44/26a-A11	55.2	-72.8	439645.3	5990561.1	3954.8	15.6.13	PRODUCER	COMPLETED_SHUT_IN
44/26c- 5	22.9	-78.3	435605.1	5984909.9	0.0	16.1.94		AB3
44/26c- 6	22.9	-78.3	435583.0	5984849.3	4670.1	6.3.94		AB3

Already abandoned

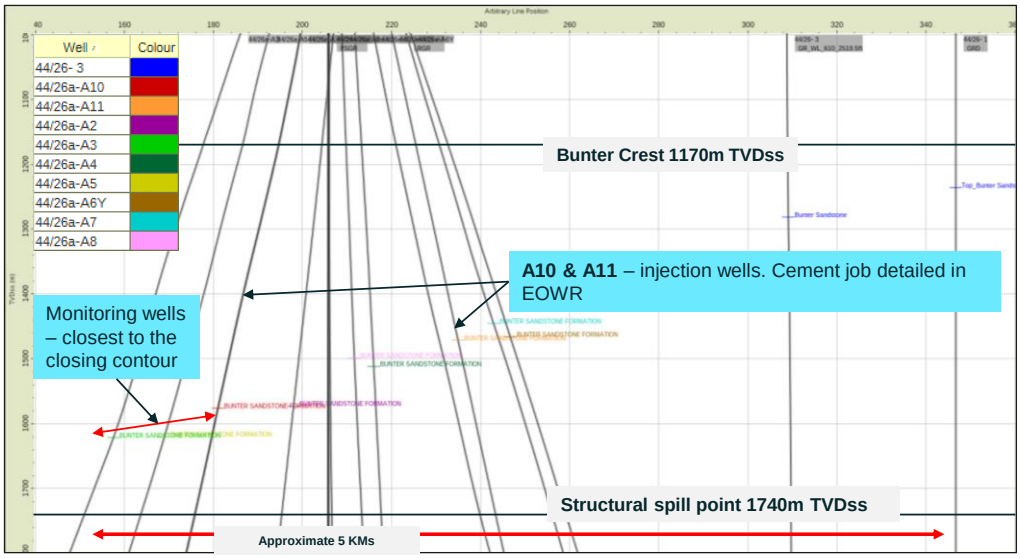
Can be considered – still to be decommissioned

In the table are shown all the wells that penetrate the Bunter Closure 36, most are producer wells from the deeper Carboniferous Schooner field. Those in red are already abandoned so obviously cannot now be re-used for Co2 injection.

Those wells in green are still producing so can be considered as potential injectors.

The wells with the best dataset to use with the REX-CO2 software tool, were A10 &A11.

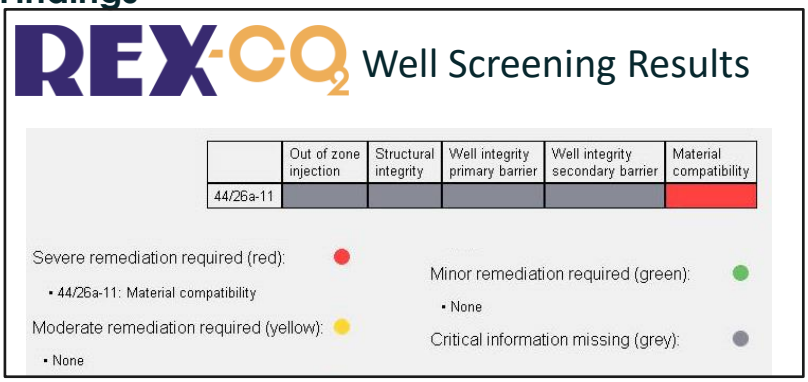
Bunter Closure 36 and Schooner Appraisal Wells



These two wells are shown in the cross section and given their position in the structure A10 is closer to the spill point and may be better suited as a CO2 monitoring well whereas A11, nearer to the crest, is better placed as an injector.

Since A11 has the most favourable position it was used with the tool.

Initial Study Findings



- Using the A11 well data with REX-CO2 selection tool, it identified key engineering and integrity parameters that need attention before confirming the well can be re-used.
- Note: The files and reports used to run the selection tool were from publicly available data sources. Operators will have access to more, and up to date, data that may result in fewer issues being identified.
- Re-using wells for injecting CO_2 gives potential for saving costs and avoiding additional leak points in the cap rock and a method to evaluate a well's suitability is through BGS CO_2 stored database and REX-CO2 software tool.

Thank you

REX-CO2

Ikon SCIENCE

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Link to the project's website:

https://rex-co2.eu/about.html