

Peer Review Report

Review Report on Use of Subsurface Geology in Assessing the Optimal Co-location of CO₂ Storage and Wind Energy Sites

Original Research, Earth Sci. Syst. Soc.

Reviewer: Davide Gamboa

Submitted on: 03 May 2022

Article DOI: 10.3389/esss.2022.10055

EVALUATION

Q 1 Please summarize the main findings of the study.

The manuscript focuses on the assessment of a depleted gas field, namely the Pickerill Field, as a potential site for CCS on the Southern North Sea. The storage estimates take into account the production history of the field, thus a fair amount of data is available to support the study. After a detailed analysis of the field's structural compartmentalisation and distribution of best reservoir quality areas, three main storage compartments are presented which yield, based on the assumed calculations, the potential to store 32 MtCO₂ in the depleted field. An aspect focused on the study is the issue of offshore space management, as a wind farm is planned for the same area of the Pickerill Field. The author present a scenario for coexistence of both carbon mitigating technologies.

Q 2 Please highlight the limitations and strengths.

The main strength resides on the provision of yet another case study to support the implementations of CCS in the North Sea. These are necessary, and judging by the details provided this work is part of a broader roadmap towards this objective. It also makes use of vintage data from the gas production phase, which not necessarily new show that the legacy data is a valuable resource for subsurface storage.

The limitations presented reside mostly on the method for calculation that assumes the direct equivalent of gas space being available for ccs, something which may overestimate potential. Not that this is necessarily wrong, and that is a limitation with static models, but no note on potential errors is made.

Q 3 Please comment on the methods, results and data interpretation. If there are any objective errors, or if the conclusions are not supported, you should detail your concerns.

I have no issues with the methods, results and interpretation. My remark on this aspect will go towards the lack of a longer seismic profile across the field, which could be complemented by three further profiles along each compartment. These aspects would show more data to support the interpretations made. Additional labels in several figures would help.

Regarding the conclusions, they are, I would say, well supported, yet incomplete. The final point discussing the shared space with the windfarm only mentions the other fields, yet on the caption of figure 14 it is explained that the potential storage volume for the other fields has been calculated. Not mentioning this increased potential undermines the whole idea the authors want to sell.

Still on this aspect of marine space management, the authors present known and valid arguments but not necessarily new as there have been papers published on this matter. Yet, none of those are referenced.

Q 4 Check List

Is the English language of sufficient quality?

Yes.

Is the quality of the figures and tables satisfactory?

Yes.

Does the reference list cover the relevant literature adequately and in an unbiased manner?

Yes.

Are the statistical methods valid and correctly applied? (e.g. sample size, choice of test)

Not Applicable.

If relevant, are the methods sufficiently documented to allow replication studies?

Yes.

Are the data underlying the study available in either the article, supplement, or deposited in a repository? (Sequence/expression data, protein/molecule characterizations, annotations, and taxonomy data are required to be deposited in public repositories prior to publication)

Yes.

Does the study adhere to ethical standards including ethics committee approval and consent procedure?

Yes.

If relevant, have standard biosecurity and institutional safety procedures been adhered to?

Not Applicable.

Q 5 Please provide your detailed review report to the editor and authors (including any comments on the Q4 Check List):

The manuscript by Jonge–Anderson and Underhill presents a case–study on the use of a depleted gas field, namely the Pickerill Field, as a potential site for CCS on the Southern North Sea. After a detailed analysis of the field's structural compartmentalisation and distribution of best reservoir quality areas, three main storage compartments are presented which wield, based on the assumed calculations, the potential to store 32 MtCO₂. An aspect focused on the study is the issue of offshore space management, as a wind farm is planned for the same area of the Pickerill Field, and a scenario for coexistence of both carbon mitigating technologies.

This study complements existing storage potential works, and much more in this line will surely follow in the next several years. Its use of legacy data is very useful and made clear and can set an example for posterior studies in other fields. I have made my comments on pdf file uploaded to the submission system, so please use it as the main base for the review. The majority of comments will tackle somewhat minor issues, with some suggestions for text clarity and avoid possible ambiguous meanings, suggestions for figure labelling, or content of figure captions. There are, however, more relevant points that I highlight here, with these being also replicated (possibly with more detail) in the uploaded file.

Although there is good data to support the majority of the interpretations and observations, the manuscript would gain with a seismic profile running along the field length, preferentially crossing from faults/compartiment boundaries. This could be complemented by three additional profiles along the length of the three compartments. The two profiles across the field, although sometimes seemingly limited, do provide good information. What they may lack is some annotations to pinpoint relevant features. Annotations, labels and titles could benefit other figures as well.

The method used is clear and based on some static assumptions. While not necessarily wrong, this could gain with some brief clarifications on limitations and errors, especially if they can impact the storage potential and lead to lower volumes.

The discussed point on the management of offshore space for energy and other applications is timely and relevant in many ways. There are however to issues I would like to point out. The manuscript only briefly mentions the other nearby fields regarding the location, yet no mention is made that their storage potential has been calculated and how much it can add to the sequestration potential. If it is to make a case that decreasing the windfarm area would be advantageous to allow the storage of 32Gt in the Pickerill, the authors

undersell it by not adding the potential of nearby fields that would increase the capacity to about 50 Gt or so. This mention to calculated volume for the other fields is only present in the caption of figure 14, but there it has little impact for the discussion.

Still on this matter of marine space management, there have been previous works tackling or drawing attention to this issue in the past. I have mentioned one from 2014, but there are likely to be others published since then. Yet not a single reference is used on the discussion of this matter, apart from an Orsted report from 2022, or even in the introduction where this issue could be presented.

Despite eventually being a bit numerous, I believe the majority of the comments should be fairly simple to address and/or clarify, and even the addition of an extra figure with seismic profiles won't require any relevant alterations of the manuscript structure. I hope the authors see them to be useful and improve the manuscript, which is surely worth publication in ES3.

Best regards,

Davide Gamboa

QUALITY ASSESSMENT

Q 6	Originality	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q 7	Rigor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 8	Significance to the field	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Q 9	Interest to a general audience	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 10	Quality of the writing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Q 11	Overall quality of the study	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>